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GEOTECHNICAL DIVER TOOLS

Operation And Maintenance Manual

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fix p → Keywords: Assembly, Operation, Core handling, Scheduled maintenance, Troubleshooting, Corrective maintenance, Illustrated parts breakdown, Tool kit, Shipping and storage, Data analysis,

CHAPTER 1

GENERAL INFORMATION AND SAFETY PRECAUTIONS

1.1 SAFETY PRECAUTIONS

Specific safety precautions for each tool are included in the chapter on the tool. In general, the geotechnical diver tools are simple, hand-operated tools that present no serious hazards. Some general safety precautions are listed below.

The following general safety precautions apply to both personnel and equipment and should be considered as supplemental to the specific safety precautions listed for each tool in the chapter on that tool:

1. Do not assemble, operate, or repair the geotechnical diver tools without first reading and understanding the appropriate portions of this manual.

2. Do not make any unauthorized alterations to the geotechnical diver tools.

3. Use cleaning solvents and lubricating substances in well-ventilated areas only. Avoid prolonged breathing of fumes or contact with skin.

4. Store and handle gasoline engine and gasoline supply properly. Do not smoke or use flame near gasoline.

5. Consult a geotechnical engineer for proper interpretation and application of the geotechnical data gathered by these tools. Geotechnical advice is available through the Seafloor Soils Division, Code L42, Naval Civil Engineering Laboratory, Port Hueneme, CA 93043, phone (805) 982-5376.

1.2 INTRODUCTION

This manual provides a complete source of information on the operation and maintenance of and data analysis for the following six geotechnical diver tools:

1. Impact Corer
2. MSPT (Miniature Standard Penetration Test)
3. Vane Shear
4. Rock Classifier
5. Jet Probe
6. Vacuum Corer

These six tools are shown in Figure 1.1. Information is also included on how to plan a geotechnical site survey using these tools. The tools listed above have been developed by the Naval Civil Engineering Laboratory (NCEL) and are designed for hand-operation by Navy divers using scuba gear.

These tools provide the divers with the capability to gather marine geotechnical (seafloor soil) data with a standard set of tools rather than using nonstandardized, makeshift methods. At present, no such tools are available to Navy divers to gather this type of data. Marine geotechnical data are information gathered on seafloor soils that can be applied to engineering problems that involve the seafloor. These engineering problems can include site selection; calculating embedment depths and breakout forces; designing anchoring systems and calculating anchor holding capacities; designing foundations for structures in the marine environment, such as piers, sewer outfalls, pipelines, cable tiedowns, and various other structures; and the design of any device that will interact in any way with the seafloor (Figure 1.2). The type of data gathered with these tools, ge-

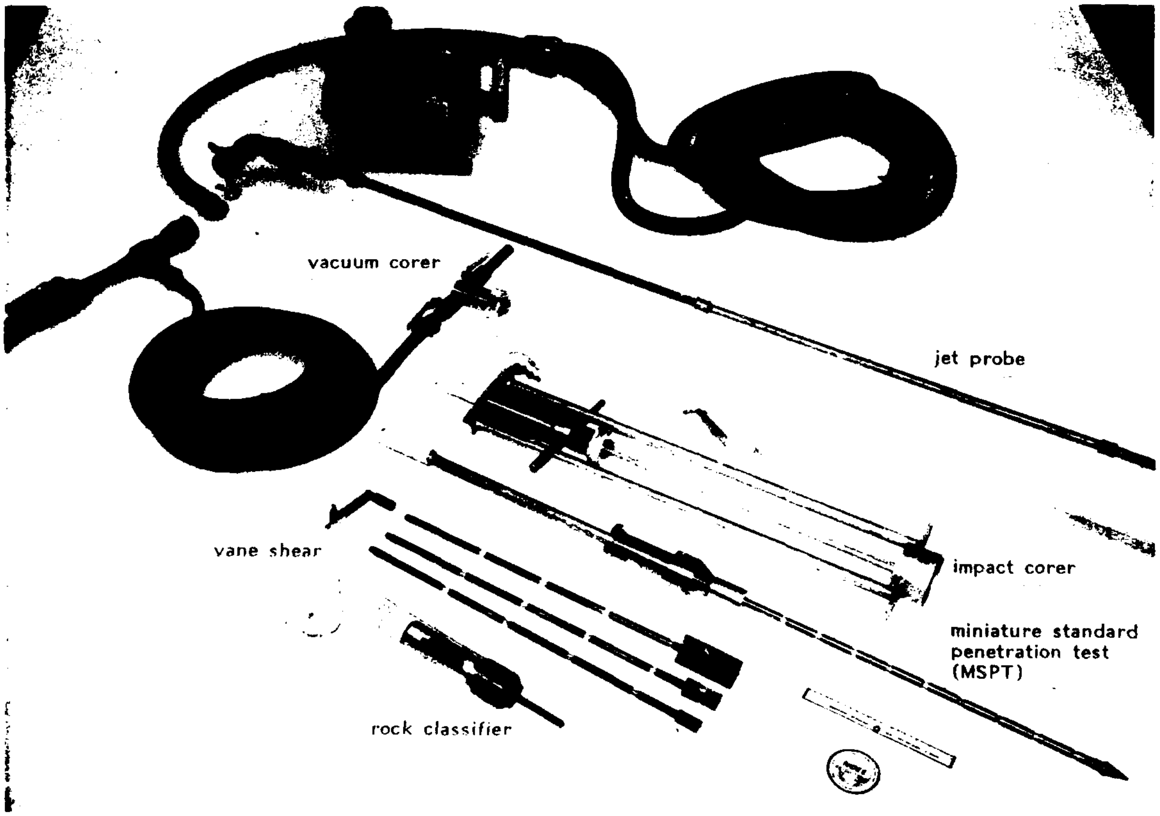
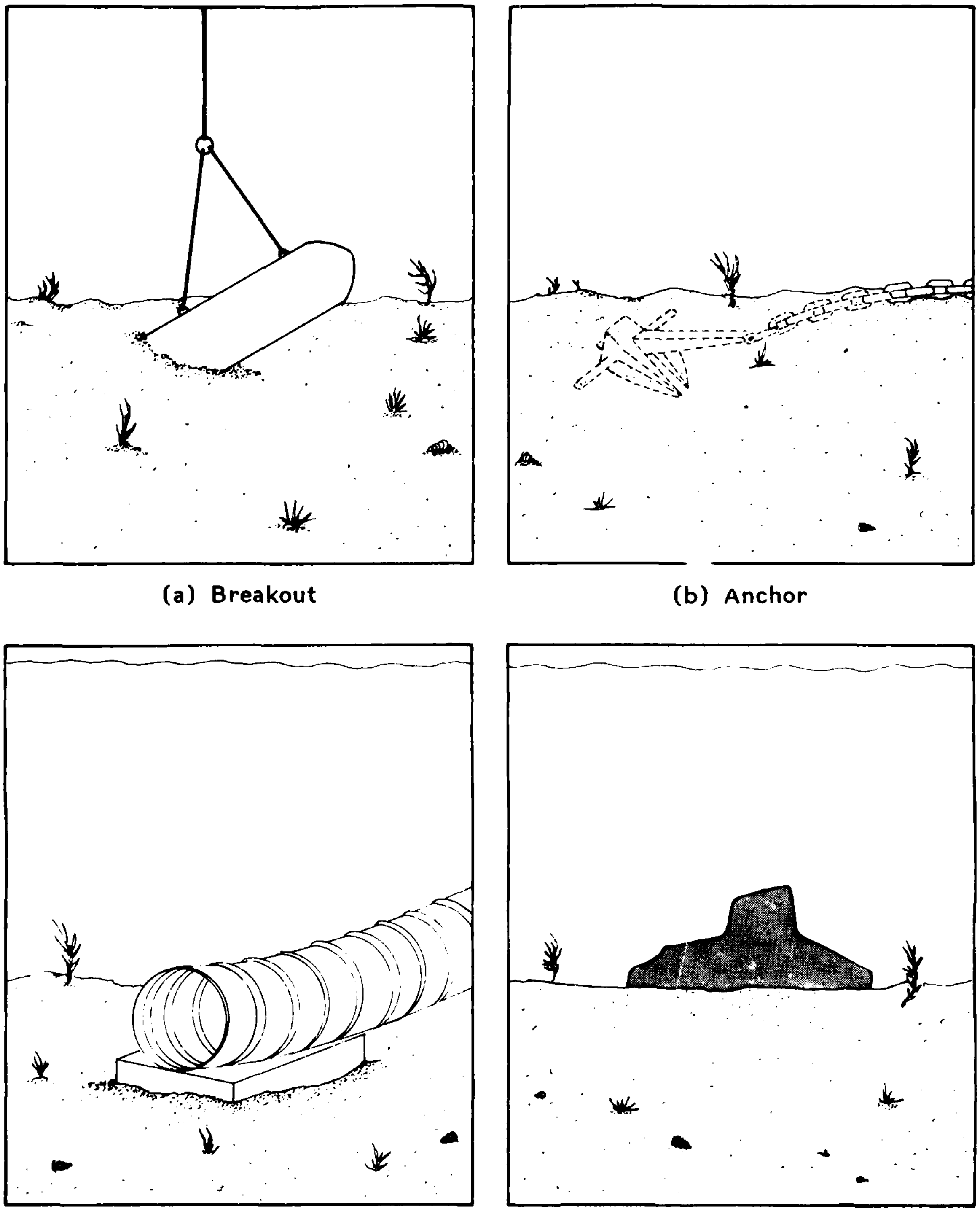


Figure 1.1. The six geotechnical diver tools.

otechnical data, is different from other types of seafloor data, such as geological data, acoustical data, or seismic data, in that the soil is tested for its engineering mechanical and structural properties.

Geotechnical data can be obtained by two methods; each has advantages and disadvantages. Soil samples can be taken from the seafloor and then tested in a geotechnical laboratory with specialized equipment (Figure 1.3) or the soil can be tested in-situ (Figure 1.4), which means within its natural site in the seafloor. By using the first method, testing a sample in the laboratory, a wide variety of tests can be done with precise techniques. However, the results from these laboratory tests will be different from the results of the same test done in-situ. This is because the laboratory sample has been "disturbed." This disturbance is caused by a number of factors. First, the sample has been removed from its natural site and the in-situ stresses from the surrounding soil are no longer acting on the sample (Figure 1.5). Second, the coring process disturbs the structure of the soil particles (Figure 1.6). Third, the temperature change from the cold seafloor to the earth's surface (especially a sunny ship's deck) stresses the soil. And fourth, the vibrations associated with handling and transporting the sample tend to cause changes in the density and structure of the soil sample. The term "disturbed" sample will be used throughout this manual and it refers to the term as explained above. To avoid testing a disturbed sample, the test can be done by the second method, which is in-situ. However, trying to measure engineering properties in-situ can be difficult, if not impossible, especially underwater. This set of tools does both types of testing. The impact corer takes a relatively undisturbed soil sample (core) for laboratory analysis. The vacuum corer takes a very disturbed sample that has limited use



(a) Breakout

(b) Anchor

(c) Pipeline and foundation

(d) Vehicle on seafloor

Figure 1.2. Situations requiring geotechnical data about the seafloor.

Figure 1.3. A geotechnical laboratory.

Figure 1.4. In-situ geotechnical testing.

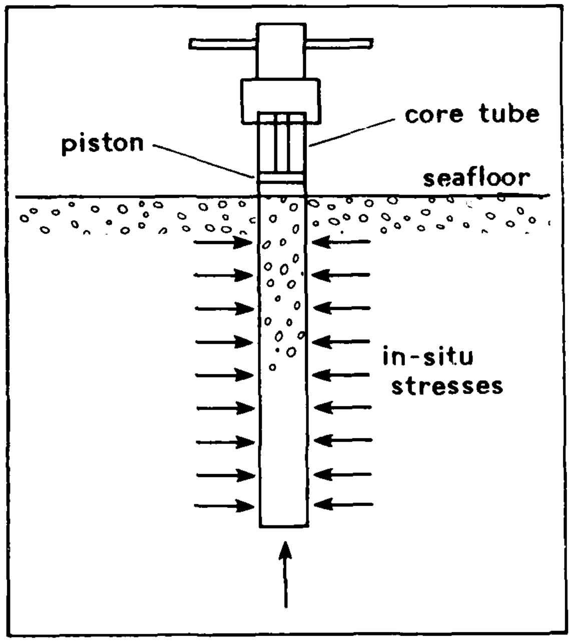


Figure 1.5. In-situ stresses.

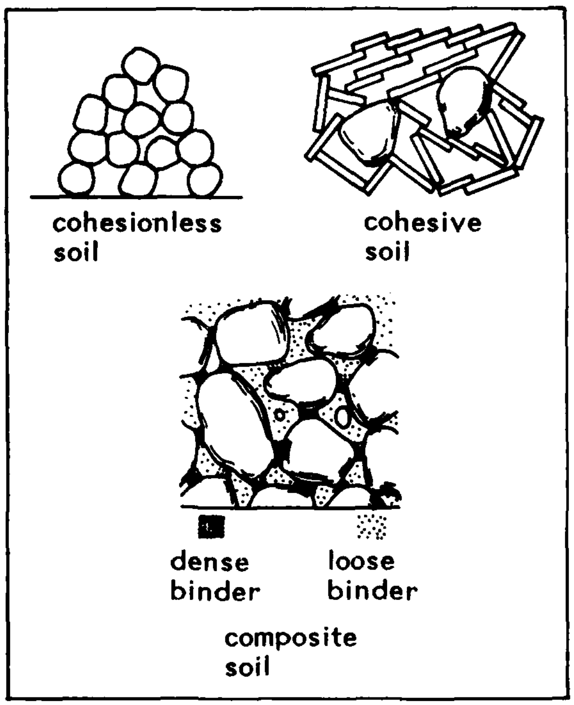


Figure 1.6. Soil structure in-situ can be easily disturbed and that can change the geotechnical properties measured.

r laboratory testing. But, the vacuum core an be used to determine the stratigraphy (soil layering) up to a depth of 8 feet. The vane shear, MSPT, rock classifier, and jet probe all take in-situ data.

The type of seafloor material tested with these tools can be categorized into three groups: cohesive soils, noncohesive soils, and rock. A cohesive soil is one that tends to stick together when rolled around in your hand (Figure 1.7). These soils can also be called clays, muds, and sometimes silts. A noncohesive soil is one that does not stick together when rolled around in your hand (Figure 1.8). These soils can also be called sands, silts, granular, or frictional soils. The third type of material, rock, is a relatively hard material. There is some overlap between the types of materials. A silt can behave as a cohesive material or as a noncohesive material depending on the particular soil and what is being done to the soil. The distinction between a clay and a silt depends on what definitions you are using. The break between a very, very stiff soil and a very, very soft rock also depends on what definitions you are using (Figure 1.9). Geotechnical definitions for these soils are included in the glossary. Therefore, for these reasons and others too involved to discuss in this manual, it is recommended that a geotechnical engineer be consulted to assist with the analysis of the data gathered with these tools.

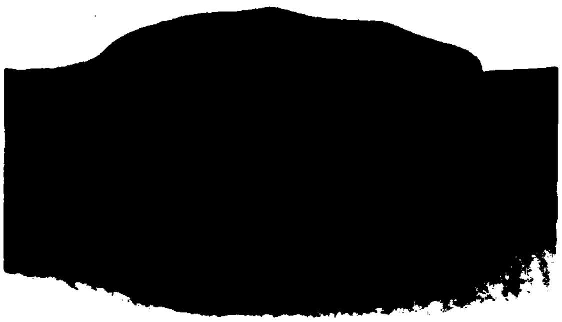


Figure 1.7. A cohesive soil.

Figure 1.8. A non-cohesive soil.

Figure 1.9. Is this a very dense sand or a very soft sandstone?

1.3 SYSTEM DESCRIPTION

The set of Geotechnical Diver Tools is a self-contained system consisting of the following six tools:

1. Impact corer
2. MSPT
3. Vane shear
4. Rock classifier
5. Jet probe
6. Vacuum corer

These tools are in fly-away packaging containing spare and repair parts, support equipment (Figure 1.10), and this operation and

maintenance manual. Two complete sets of the Geotechnical Diver Tools will be added to the Table of Allowance of the Ocean Construction Equipment Inventory (OCEI) maintained by the Chesapeake Division of the Naval Facilities Engineering Command (NAVFAC). The OCEI will assume engineering cognizance and provide logistics support for the tools. The tools will be drawn out of the OCEI by the divers as they are needed. The divers using the tools will be responsible

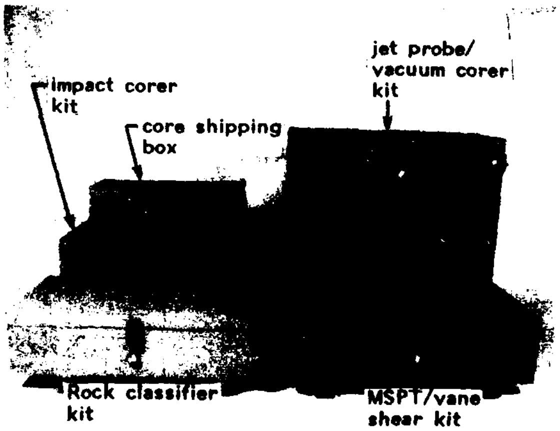


Figure 1.10. One complete set of geotechnical diver tools.

for on-site maintenance of the tools, for providing freshwater to wash down the tools, and for fuel for the gasoline engine on the waterpump. The OCEI will be responsible for all other maintenance and support of the tools. Some tools, such as the rock classifier, may need to be returned to the manufacturer for maintenance.

The geotechnical diver tools are designed to be hand-operated by two divers wearing wetsuits and three-fingered wetsuit gloves. The tools can be operated from the beach, a pier, or from a diver support craft in any of the world's oceans, bays, harbors, rivers, or lakes where Navy divers might be requested to obtain geotechnical data. The tools are designed to operate in water depths from 0 to 130 feet, a 1-knot current, sea state 3, and water temperatures from 28 to 90°F. The tools are constructed of materials that are compatible with seawater, and the tools are either neutrally or negatively buoyant. Geotechnical data can be taken to a soil depth of 30 inches with the impact corer, vane shear, and MSPT tools. The rock classifier takes surface rock data. The vacuum corer obtains soil data to a depth of 8 feet, and the jet probe can reach a depth of 10 feet.

The packaging for the Geotechnical Diver Tool System is designed to be a fly-away system that is transportable by military or commercial aircraft, truck, or ship. The tools are packaged in four boxes (Figure 1.11):

Box 1: Impact Corer Kit (Figure 1.11a)

Box 2: Vane Shear Kit and MSPT Kit (Figure 1.11b)

Box 3: Rock Classifier Kit (Figure 1.11c)

Box 4: Vacuum Corer Kit and Jet Probe Kit (Figure 1.11d)

Each box is constructed of plywood and designed to be carried by two people. The boxes contain all the spare and repair parts necessary to maintain the tools in the field except for freshwater to wash down the tools and fuel for the gasoline engine on the water pump. Each kit also contains support equipment, such as diver slates, data sheets, and calibration equipment.

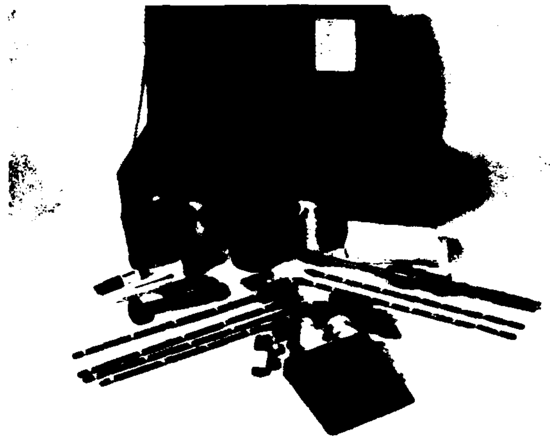
This manual contains all the normal operation and maintenance information plus a section (Chapter 2) on planning a geotechnical site survey. Within the chapter for each tool there is a section on the analysis of the data taken with that tool. A laminated summary sheet for each tool covering the tool assembly and tool operation is included in each box.

1.4 GEOTECHNICAL DIVER TOOL DESCRIPTIONS

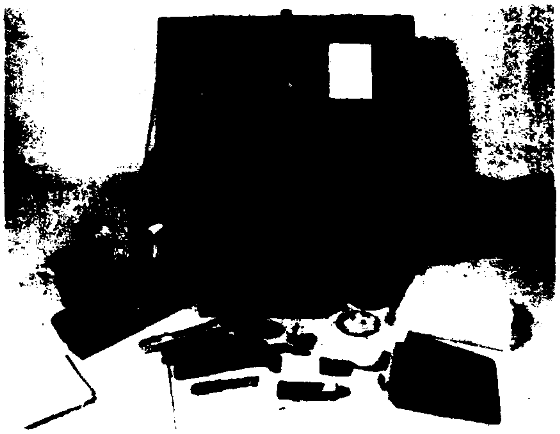
The six geotechnical diver tools (Figure 1.1) will be described briefly along with how they are operated and the kind of data they take. More detailed descriptions can be found in the chapters covering each tool. These tools are rather basic, but they do provide divers with the ability to gather data without the use of large, heavy equipment requiring the support of a large ship.

The tools needed for each site survey will

(a) Impact corer kit



(b) MSPT/vane shear kit



(c) Rock classifier kit

(d) Jet probe/ vacuum corer kit

Figure 1.11. Geotechnical diver tool system.

depend on the requirements of that specific job. If specific data are requested, the proper tools can be selected and taken. If specific data is not requested, or if nothing is known about the site, the whole set will have to be taken and the decisions made at the site on which tools to use.

1.4.1 Impact Corer

The impact corer (Figure 1.12) takes a soil sample (core) 30 inches long and 1.5 inches in diameter in a clear Lexan plastic tube. This tube is supported by a frame that also contains a built-in impact hammer to drive the core tube into the soil. This corer has a piston in the core tube designed to stay at the seafloor surface to create a suction within the tube and help retrieve a relatively undisturbed soil sample. This corer can take a core in almost any type of soil. The amount of sample retrieved in the core tube will depend somewhat on the soil type. The core, sealed in the core tube, can be sent to a geotechnical laboratory for testing. Laboratory testing can provide data from the core, such as the

following:

- grain size distribution
- wet density
- dry density
- water or moisture content
- specific gravity
- Atterberg limits
- vane shear strength or sensitivity
- strength
- friction angle
- organic carbon and carbonate content

If any of these data are asked for from a geotechnical site survey, a core using the impact corer will be required.

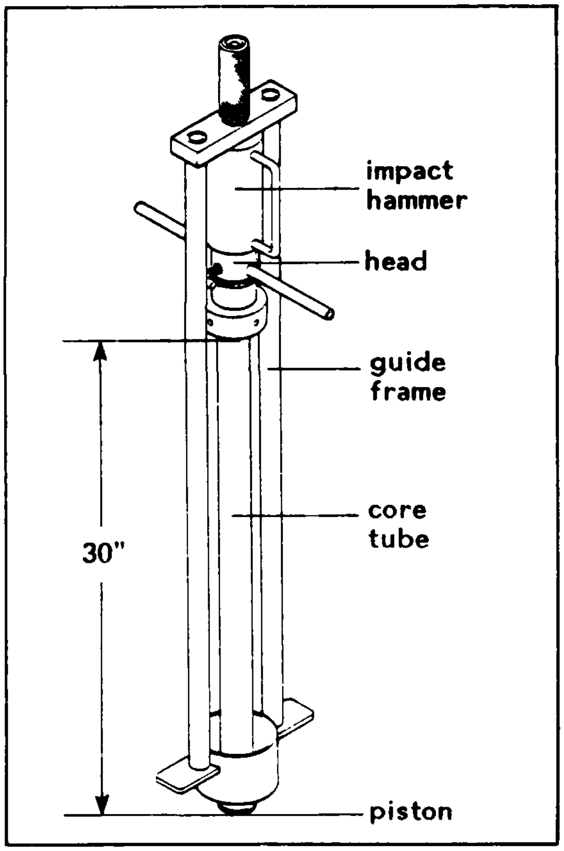


Figure 1.12. Impact corer.

1.4.2 Vane Shear

The vane shear tool (Figure 1.13) takes in-situ strength data called vane shear strength in cohesive (mud) soils only. Data taken with this tool in cohesionless (sand) soils is mean-

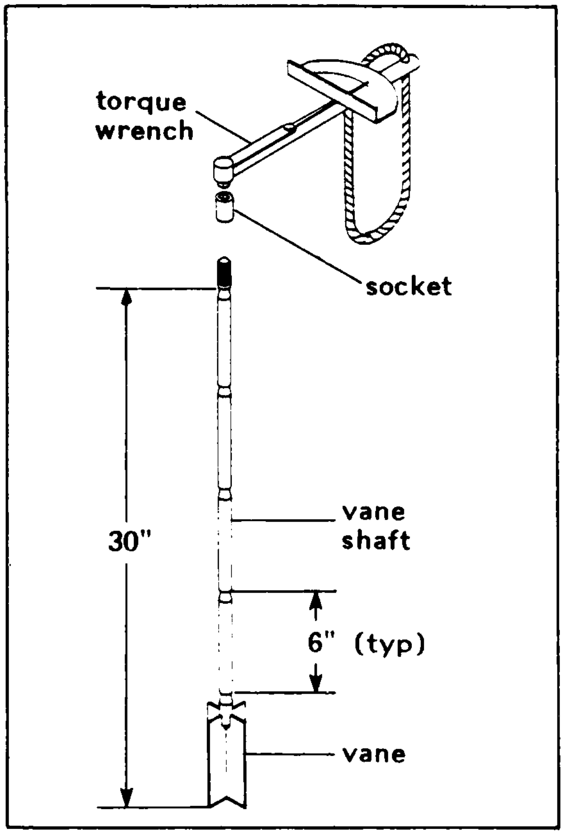


Figure 1.13. Vane shear.

ingless. The vane shear tool consists of a shaft with a four-bladed vane on the bottom end and a small beam style torque wrench that attaches to the top end of the shaft. The vane is pushed into the soil and then turned using the torque wrench until the soil gives way (fails). The maximum torque reached at the point the soil failed is marked by a memory marker and is read and recorded. This torque (inch-pounds) can later be converted to vane shear strength (pounds per square inch) by using the torque in an appropriate equation. Vane shear data can be taken to a depth of 30 inches. If in-situ strength data are asked for and the site has cohesive soil, the vane shear tool should be used.

1.4.3 MSPT

The Miniature Standard Penetration Test (MSPT) tool (Figure 1.14) takes in-situ data in cohesionless soils (sand). This tool consists of a shaft with a cone on the bottom end and a

hammer on a guide shaft on the top end. The hammer is raised to the top of the guide shaft and then allowed to fall freely to the anvil on top of the cone shaft. The number of times the hammer is dropped (called hammer blow count) to drive the cone shaft into the seafloor in 3-inch increments are counted. This is repeated until the MSPT penetrates a full 30 inches or until 50 hammer blows does not cause 3 inches of penetration. The number of blow per 3-inch increment is an indication of the relative density of the sand. When in-situ data are needed in a cohesionless soil, the MSPT tool should be used.

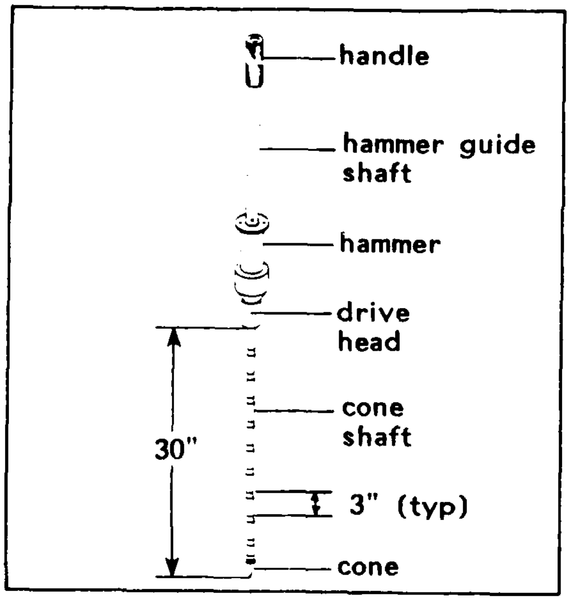


Figure 1.14. MSPT.

1.4.4 Rock Classifier

The rock classifier (Figure 1.15) takes rock strength data on the surface of rock. This tool is a standard rock classifier used on land that has been put in a watertight housing for underwater use. The rock classifier has a metal plunger that is pressed against the rock surface; then an internal hammer strikes and rebounds off the plunger to measure the rock's hardness. The hardness is a number (rebound number) read off a scale on the side of the rock classifier and then recorded. This rebound number can be converted to rock compressive strength from a chart. If rock compressive strength is asked for, the rock classifier should be used. Also, if possible, a small sample of rock should be brought back for visual identification.

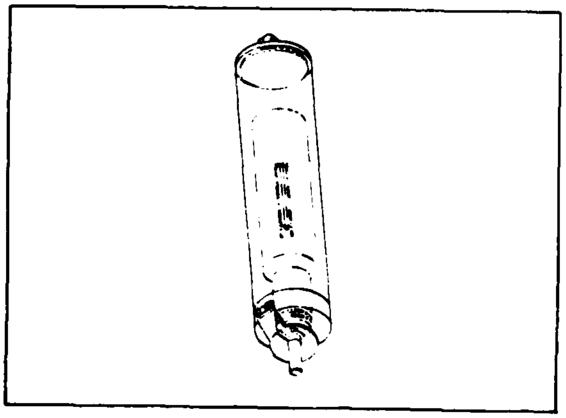


Figure 1.15. Rock classifier.

1.4.5 Jet Probe

The jet probe (Figure 1.16) is used to probe the sediment in search of bedrock or other firm layer within 10 feet of the seafloor surface. The tool is simply a 1/2-inch-diam

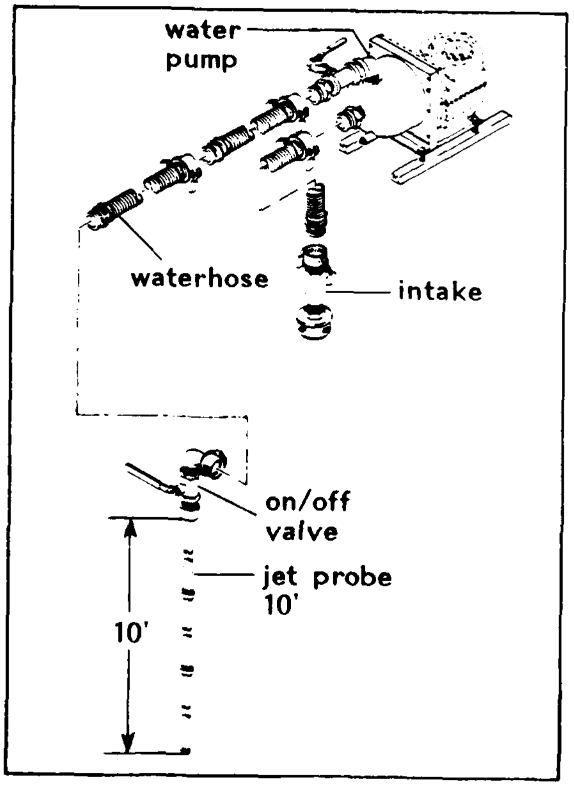


Figure 1.16. Jet probe.

steel pipe 10 feet long that is connected to a waterpump by a hose. Water flows through the pipe, which allows the pipe to be pushed into the soil very easily. If the depth of sediment is asked for, or if there is rock or cobbles in the area, the jet probe can be used to determine if they are within 10 feet of the sediment surface. The jet probe can also be used to verify subbottom profile data.

1.4.6 Vacuum Corer

The vacuum corer (Figure 1.17) takes a soil sample up to 8 feet long. This tool has a clear plastic core tube that is attached to a suction hose with control valves. The suction in the suction hose is created by an eductor connected to a waterpump by another hose. The suction is used to help push the core tube into the soil and to help suck up the sample. This vacuum is difficult to control; it can suck up soil from the side rather than straight down, and it will suck up more in a soft layer than in a hard layer. The core taken with the vacuum corer is very disturbed, but it does provide a sample from a depth that cannot be reached with the impact corer without using large, heavy shipboard equipment. This sample can be used to see what type of soil is at that depth and what kind of layers may exist.

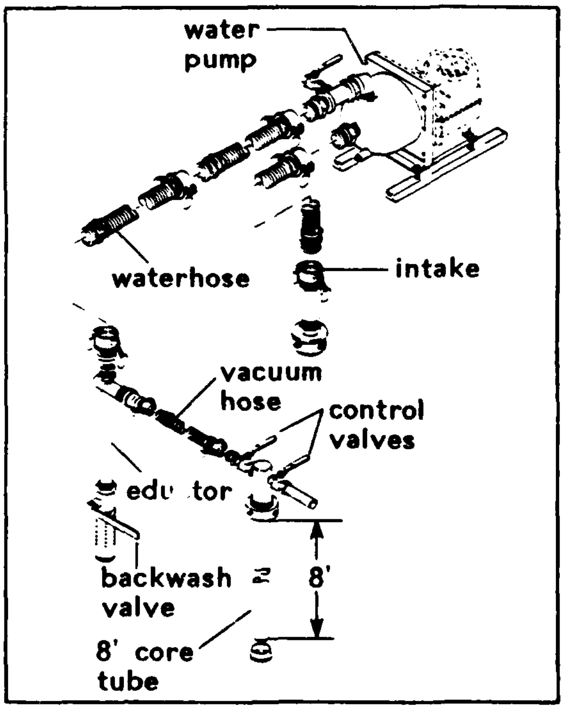


Figure 1.17. Vaccum corer.

1.5 MANUAL DESCRIPTION

This manual is divided into nine chapters:

Chapter 1--General Information
Chapter 2--Geotechnical Site Survey
Chapter 3--Impact Corer
Chapter 4--MSPT
Chapter 5--Vane Shear
Chapter 6--Rock Classifier
Chapter 7--Homelite Waterpump
Chapter 8--Jet Probe
Chapter 9--Vacuum Corer

Each chapter covering a tool (Chapters 3, 4, 5, 6, 8, and 9) is broken down into the following sections:

- General Information
- Functional Description
- Operation
- Scheduled Maintenance
- Troubleshooting
- Corrective Maintenance
- Illustrated Parts Breakdown
- Tool Kit and Contents
- Packaging, Handling, Storage, and Transportation Kit
- Procurement Information

Before using the set of geotechnical diver tools, the entire manual should be read and understood. If only specific tools are to be used rather than the whole set, Chapters 1 and 2 should be read and understood along with the chapters covering the specific tools that will be used. The jet probe and vacuum corer both use the Homelite waterpump, so Chapter 7 should also be read if either one of these tools is to be used. Chapter 7 also includes information on shipping regulations. Appendix A is a glossary to clarify the terms and symbols used in the text. Blank data sheets for photocopying are provided in Appendix B. A bibliography of geotechnical references is also included as Appendix C.

CHAPTER 2

GEOTECHNICAL SITE SURVEY

2.1 INTRODUCTION

This chapter presents some guidelines for planning and carrying out a geotechnical site survey using the geotechnical diver tools. Planning a geotechnical site survey involves such things as deciding which geotechnical tools are needed to do the job, how much data need to be taken with the tools, and where to take the data within the site. The actual site survey will require that the tools are used correctly to get the needed data and that the location where the data are taken is properly recorded. These issues and others will be discussed in this chapter.

The end result of a geotechnical site survey will be geotechnical data. These data should be presented on data sheets, which are provided with the tools. Example data sheets are shown throughout the text as their use is explained; a set of sheets is provided in Appendix B. This set of data sheets includes the following:

(1) Geotechnical Site Survey Planning Sheet (Figure B.1)

(2) Geotechnical Site Survey Summary Sheet (Figure B.2)

(3) Site Sketch Sheet (Figure B.3)

(4) Site Data Sheet (Figure B.4)

(5) Core Data Sheet (Figure B.5)

(6) Vane Shear Data Sheet (Figure B.6)

(7) MSPT Data Sheet (Figure B.7)

(8) Rock Classifier Data Sheet (Figure B.8)

(9) Jet Probe Data Sheet (Figure B.9)

(10) Tool Failure and Inadequacy Report (Figure B.10)

When a geotechnical site survey is completed, a set of data sheets should be assembled, including sheets 1, 2, and 3 above and as many tool data sheets as necessary to document all the data taken. This set of data sheets and any laboratory testing data (from cores taken) should be your final product. If there are any problems with the tools or the kits, a Tool Failure and Inadequacy Report (Figure B-10) should be filled out and sent to Code L42, Naval Civil Engineering Laboratory, Port Hueneme, CA 93043.

2.2 PLANNING A GEOTECHNICAL SITE SURVEY

To plan a geotechnical site survey, some preliminary information should be gathered. This information includes items like the purpose of the survey, the type of data needed, the number of and location of points at the site where data need to be taken and, if cores are being taken, where they will be shipped for analysis. Also, any geotechnical data already available on the site should be reviewed in an effort to reduce the amount of new data to be gathered. When this preliminary information has been gathered, the tools needed can be selected and prepared, and supplies such as core tubes and data sheets can be assembled. To make this planning stage easier, a planning sheet is provided in Figure 2.1 (also Figure B.1). Each item on this sheet will be discussed in the following paragraphs, and suggestions will be offered to help with the planning.

Figure 2.1

GEOTECHNICAL SITE SURVEY PLANNING SHEET

I. GENERAL INFORMATION

1. Project: ______
2. Sponsor: ______
3. Point of Contact: ______
4. Telephone: ______
5. Purpose of Survey: ______
6. On-Site Dates: ______

II. SITE INFORMATION

7. Site of location: ______
8. Size of survey site: ______
9. How many data locations needed in site: ______
10. What is already known about site (soil type, water depth, slope, etc.): ______
11. Type of support facilities available: ______

III. SOIL DATA INFORMATION:

12. Type of data needed: ______
13. Laboratory soil analysis done by: ______
14. Geotechnical data analysis done by: ______

IV. GEOTECHNICAL TOOLS NEEDED — NO. OF CORES/DATA NEEDED

15. Impact corer ______
16. MSPT ______
17. Vane shear ______
18. Rock classifier ______
19. Jet probe ______
20. Vacuum corer ______

V. NOTES:

______

At this point, to help with the explanation of the geotechnical site survey and with the use of the tools, an imaginary project for which a site survey is required will be created and used as an example throughout the rest of the manual. This example site survey is for an imaginary project called the Special Test Project; a description of the project follows:

Example: An engineer, I.M. Engineer, at a Navy organization, NAV-ABC, needs to install an experimental facility offshore from an island in the Pacific Ocean. This facility is called the Special Test Facility and consists of a test fixture that will be in 80 feet of water and a cable from the fixture going to a data acquisition system on shore. The test site is located offshore from the Imaginary Island, which is off the coast of Southern California (Figure 2.2). A group of Navy divers, called Diver Group Five, has been asked to take the Geotechnical Diver Tools out and gather data that the engineer can use to design the test fixture and to select the cable route. An oceanographic chart of the island is available. The engineer has drawn in a selected route for the divers to survey. This is shown in Figure 2.2.

The first step in planning the site survey is to fill out the planning sheet (Figure 2.1). The planning sheet is divided into five blocks. Within these blocks are questions numbered consecutively down the page.

The first block is for general information to identify the project. Questions 1 through 4 identify the project, the sponsor, a sponsor contact who can answer questions about the project, and that person's phone number. Question 5 identifies the purpose of the project or the reason you are collecting geotechnical data and what the data will be used for. Question 6 identifies the dates the geotechnical data will be taken at the site.

Example (continued):

I. GENERAL INFORMATION

1. *Project: Special Test Facility Project*

2. *Sponsor: NAV-ABC*

3. *Point of Contact: I.M. Engineer*

4. *Phone: (802) 987-6543, A/V - 260, FTS - 399*

5. *Purpose of Survey: Geotechnical data to design test fixture and select cable route*

6. *On-Site Date: 10-20 Jun 1985*

The second block is for information about the survey site. Question 7 identifies the site location. Question 8 asks for the approximate size of the survey site. At this point, it would be very helpful to obtain an oceanographic chart of the area if one is available, and using the Survey Site Sketch Sheet sketch out the survey site, showing its approximate size and shape. Once this is done, it will be easier to answer question 9, which is how many data locations will there be within the site? The answer to this question depends somewhat on the purpose of the project and the size of the site. In general, the points at which data are taken should be spaced out to cover the area well. You are looking for changes in the soil and layering. These can occur with changes in slope and water depth or anywhere in the site over time with wave and current actions. The sponsor's point of contact may have some suggestions on this. Answering question 10 will take a little investigating. Perhaps someone has been there before who can provide some information. If an oceanographic chart is available, sometimes there are notes about the seafloor soil type on the chart. Question 11 about the support facilities available at the site might also take a little investigating to answer.

Example (continued): The second box from the planning sheet is shown below as it would be filled out for our example. This example is complicated by the fact that it is divided into three distinct areas called Site A, Site B, and Site C. Each of these sites has different soil types.

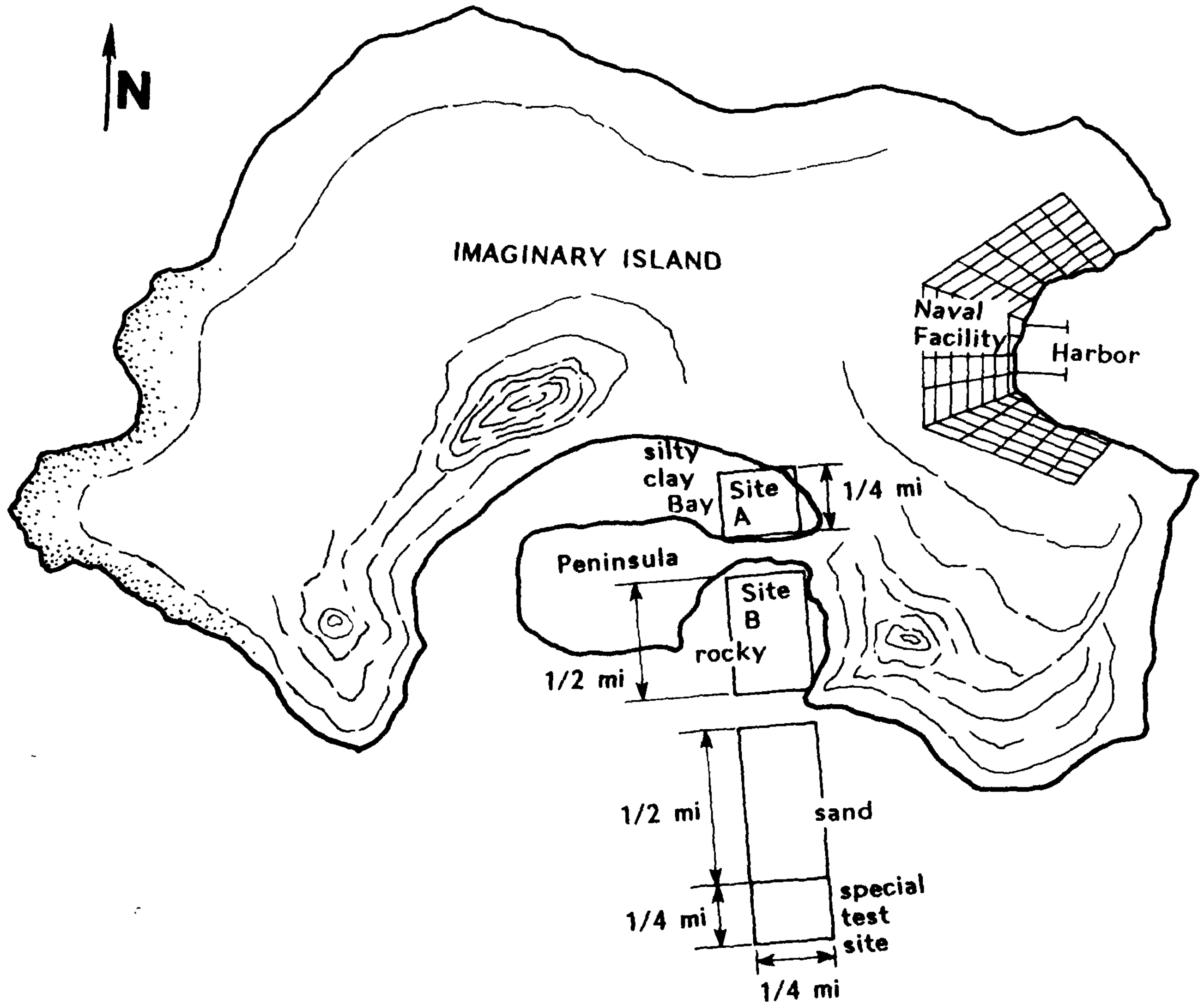


Figure 2.2. Site of example site survey.

II. SITE INFORMATION

7. *Site Location: Imaginary Island, offshore Southern California*

8. *Size of Survey Site: 3 areas: A - about 1/4 mile square; B - about 1/2 mile square, C - about 1/4 by 3/4 mile*

9. *How Many Data Locations Needed in Site: at least every quarter mile; A - 5 data locations, B - 6, C - 7*

10. *What is Already Known About Site (soil type, water depth, slope, etc.): chart says: A - clay; B - rocky, sandy; C - sand; shallow water except C where southern end is 80 ft*

11. *Type of Support Facilities Available: Small Naval facility on island - harbor with pier, landing strip for small commuter flights*

The third block is for information on the soil data to be gathered. Question 12 asks what type of data is needed. This information may be supplied by the sponsor. If cores are needed to satisfy the data requirements, question 13 -- where is the laboratory testing being done? -- must be answered. Question 14 identifies who will analyze the geotechnical data, or who the data should be sent to.

Example (continued): In our example, I.M. Engineer did not specify what type of data was required; therefore, it is up to the divers to examine the chart and try to decide what is needed. From looking at the chart and talking to a diver who had been to the island, the divers see that there are three different seafloor types: silty clay, rocky with sand, and sandy. To be sure to get all the necessary data, they decide to take cores for laboratory analysis and some in-situ data. The in-situ data will be vane shear, MSPT, rock hardness, and sediment depth over the bedrock.

III. SOIL DATA INFORMATION

12. *Type of Data Needed: cores, in-situ (vanes & MSPT), rock data, sediment, depth*

13. *Who Will Do Laboratory Testing of Cores: a local lab in California - Geotechnical Testing*

14. *Who Will Do Geotechnical Analysis: I.M. Engineer from NAV-ABC*

The fourth block is for deciding which geotechnical diver tools are needed to do the job and how much data will be taken with each. This block can be filled out from the information in blocks II and III. Then the number of core tubes, data sheets, and other expendables can be determined. If the data needed are specified, then selecting the necessary tools will be a simple matter. If the data are not specified, of if very little or nothing is known about the site, then the complete set of tools should be taken and the decision about which tools to use should be made on-site based on what is found during initial reconnaissance dives. It is a good idea to take both cores for laboratory testing and in-situ data. See Section 3.10 for help in estimating the number of cores needed from each data location to provide enough soil to do the necessary laboratory tests.

Example (continued): From the information in blocks II and III, the divers decide they need to take all the tools.

IV.	GEOTECHNICAL TOOLS NEEDED	NUMBER OF CORES/DATA
15.	______ Impact Corer	at least 18 + spares
16.	______ Vane Shear	at least 15
17.	______ MSPT	at least 13
18.	______ Rock Classifier	at least 6
19.	______ Jet Probe	all over site B, some site C
20.	______ Vacuum Corer	not needed

The fifth block is provided for any special notes for the planning of the geotechnical site survey.

Example (continued):

V. NOTES: Weather can be highly variable around this island

2.3 ON-SITE SURVEY

When you arrive at the actual site, you may find the conditions different than those you based your planning on. One of the first things you should do is compare your planned data locations with the actual site conditions and make whatever changes are necessary.

At the site, a Survey Site Sketch Sheet should be used to sketch out the survey site and to mark and label the actual data-taking locations. The label given to each data-taking location should be unique to avoid confusion. This label will be referred to as the data location ID from this point on. Another sheet, the Site Data Sheet, is available to record the actual data location coordinates taken by whatever survey method is used. The data location IDs on these two sheets should be the same. The data actually taken should be numbered consecutively. The first data taken, a core or vane shear, for example, would be identified as "data location ID-#1;" the next data would be identified as "data location ID-#2," and so on.

Example (continued): When the divers got to the site for the Special Test Project, they set up their survey benchmarks and used a Site Sketch Sheet for each site (Site A, Site B, and Site C). The diver's location coordinates were recorded on the Site Data Sheet as the data were taken. The preplanned data locations were used and were labeled as shown in Figures 2.3, 2.4, and 2.5. At Site A, each data location within that site was labeled alphabetically (data location ID's = AA, AB, AC, etc.). At Site B, each data location was again labeled alphabetically (data location ID's = BA, BB, BC, etc.). As data were taken, the data were numbered consecutively. The first core at AA was labeled AA-1 and the second AA-2. The vane shear data taken at AA were labeled AA-3. The vane shear data at site AA were repeated and these data were labeled AA-4. They continued this process until all the data had been taken.

At the end of the site survey, a summary sheet (Figure 2.6) should be filled out and attached to all the data sheets. When the geotechnical laboratory data sheets are received, they will be included and the whole set sent to the engineer.

The example presented in this chapter is just that--an example. Each situation will be different and will require that the site survey be planned to meet the specific project's needs.

SURVEY SITE SKETCH SHEET

Page

Project: Special Test Facility Project	Date:

Site Location: Imaginary Island, CA - Site A	Scale: 5 squares = 1/4 mile

LEGEND

⊗ Data location.

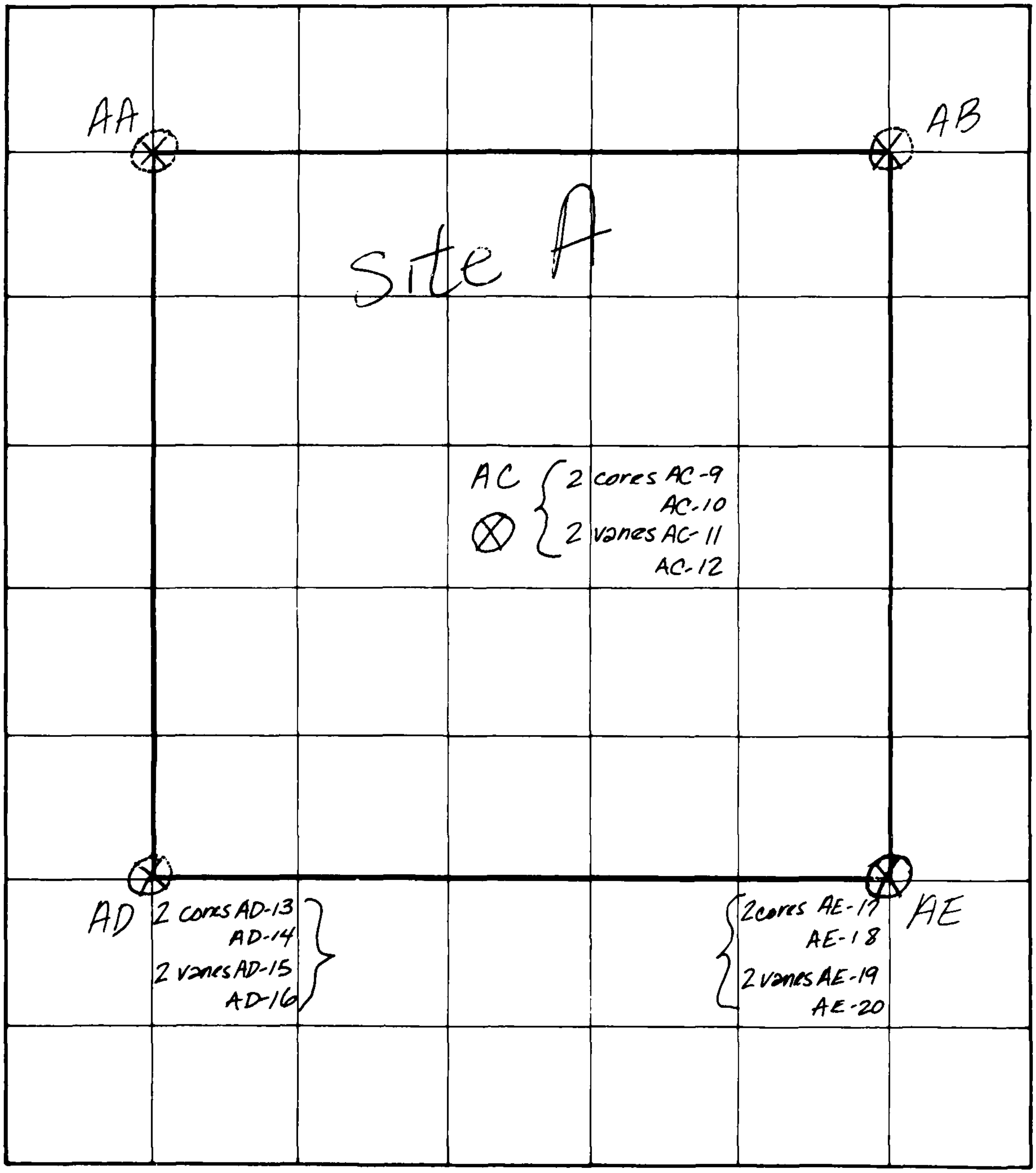


Figure 2.3. Site A from Imaginary Island (Figure 2.2) with data locations marked.

Page

SURVEY SITE SKETCH SHEET

Project: Special Test Facility Project   Date: ____________

Site Location: Imaginary Island, CA - Site B   Scale: 3 squares = 1/4 mile

LEGEND

⊗ Data location.

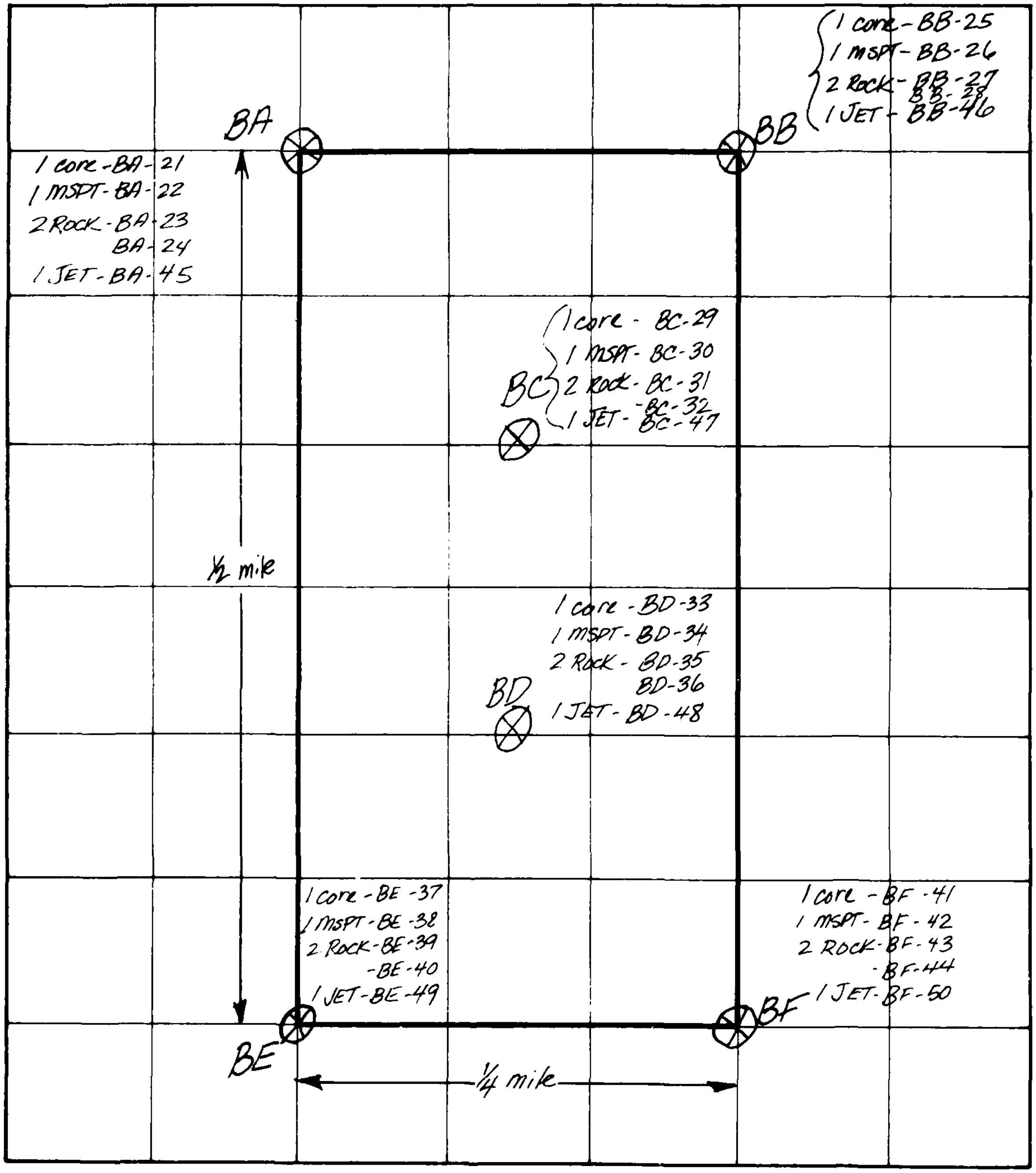


Figure 2.4. Site B from Imaginary Island (Figure 2.2) with data locations marked.

Page

SURVEY SITE SKETCH SHEET

Project: Special Test Facility Project Date: ____

Site Location: Imaginary Island, CA - Site C Scale: 2 square = 1/4 mile

LEGEND

⊗ Data location.

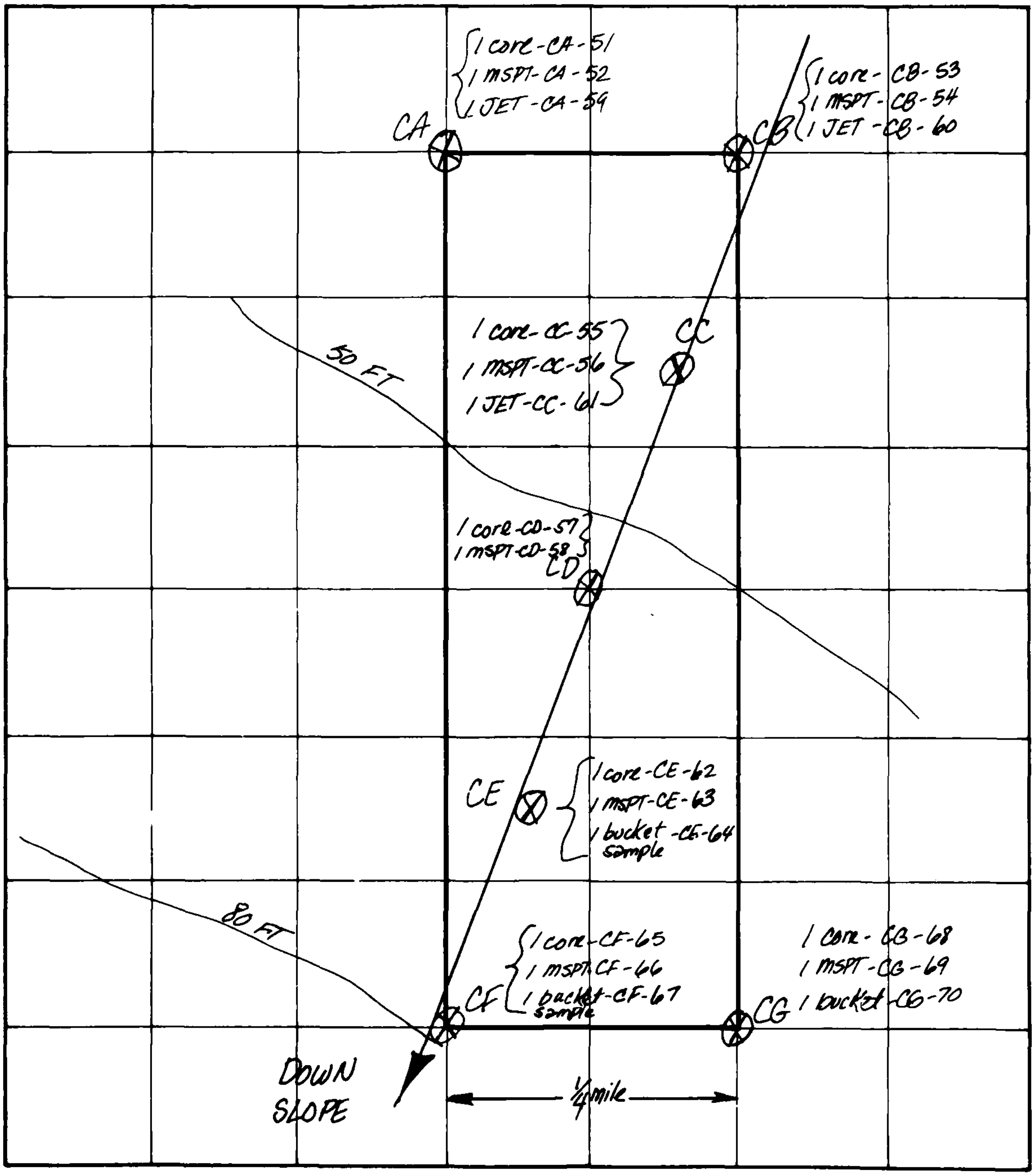


Figure 2.5. Site C from Imaginary Island (Figure 2.2) with data locations marked.

Page

GEOTECHNICAL SITE SURVEY SUMMARY SHEET

GENERAL INFORMATION

Project: Special Test Facility Project
Sponsor: NAU-ABC
Point of Contact: I. M. Engineer
Phone: (802) 987-6543 AV 2bC FTS 399
Site Location: Imaginary Island, offshore S. California
On-Site Dates: Jun 10-20
Divers: Diver Group Five
Point of Contact: Smith
Phone: (402) 123-4567 AV 430 FTS 279

GEOTECHNICAL DIVER TOOLS

Tools Used	No. of Data Points	Tool Serial No.
Impact Corer	23	
Vane Shear	10	
MSPT	13	
Rock Classifier	12	
Jet Probe	9	
Bucket Sample	3	
Total	70	

SUMMARY SITE CHARACTERISTICS

The site had three district areas that were labeled site A, B, and C. Site A was in the bay. The soil there was a soft silty sand. The average vane shear strength was 1.5 psi. Site B was offshore the point cresting the bay. The site was sandy and rocky. Exposed rock was frequent in the shallow areas. Site C was farther out from B and the proposed location for the test fixture was at the southern end. The actual water depth at the time of the survey was 87 ft. The site was sandy with some exposed rock at the northern (nearshore) end. The rock could not be detected with the jet probe (10 ft) at the southern end.

SUMMARY OF PROBLEMS

Figure 2.6. A summary sheet filled out for the geotechnical site survey done at Imaginary Island.

CHAPTER 3

IMPACT CORER

3.1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

3.1.1 General Information

The impact corer is a hand-operated diver tool that takes a soil sample 1.5 inches in diameter and up to 30 inches in length depending on the soil type. A photograph of the impact corer is shown in Figure 3.1. The major parts of the tool are identified in the photograph. The tool is 47 inches long and weighs 23 pounds in air and 16 pounds in seawater. It takes about 10 minutes to take one core with the impact corer.

The impact corer is packaged in a box (Figure 3.2) as a kit with spare parts and repair and support equipment. The kit contains supplies to take 50 cores. Supplies are included for capping and sealing the cores. The box is 4 feet long by 2 feet wide and 2 feet tall. It weighs 265 pounds when fully equipped.

The geotechnical data obtained with the impact corer result from laboratory tests run on the undisturbed sample that the corer takes. For example, the core can be used to determine grain size distribution, density, water content, Atterberg limits, specific gravity, friction angle (from direct shear tests), triaxial test data, and vane shear test data.

3.1.2 Safety Precautions

The only moving parts during operation are the hammer and the core tube. Therefore, the safety precautions are minimal and basic.

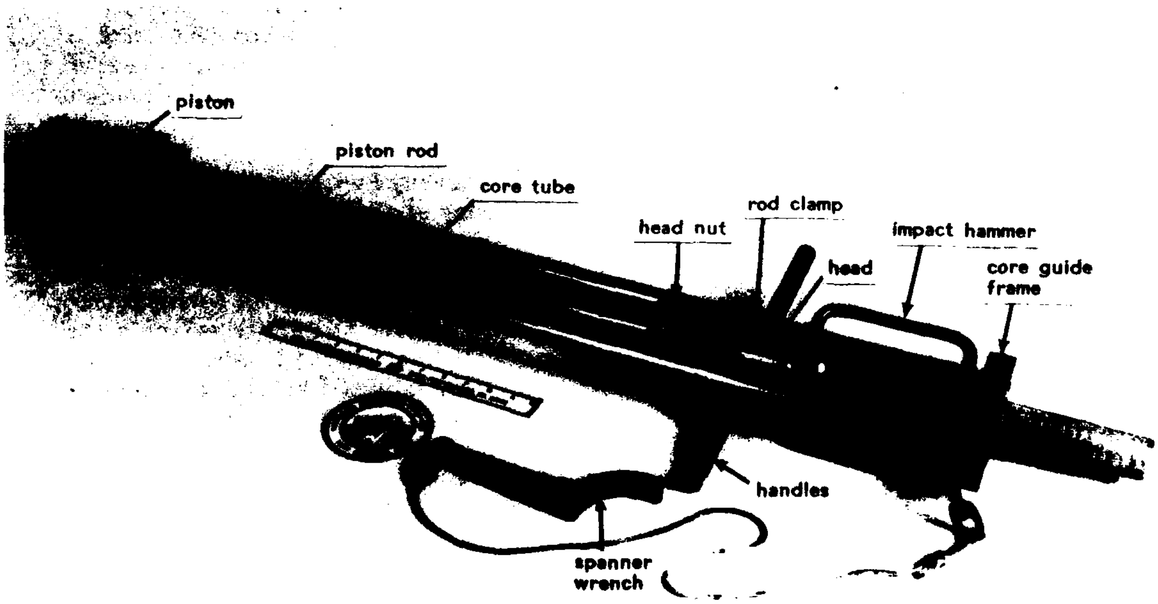


Figure 3.1 Impact corer.

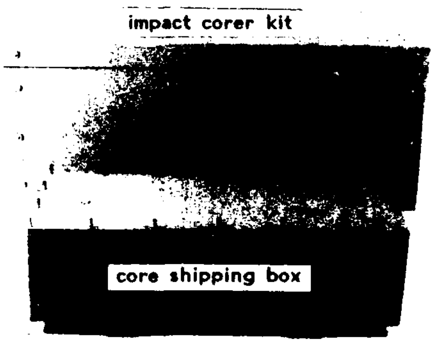


Figure 3.2. Impact corer kit box and a core shipping box.

1. Do not put your hands between the hammer and the top of the core head or between the hammer and the top of the frame.

2. Hold onto the hammer when removing the piston rod so the hammer will not fall out.

3. Use cleaning solvents and lubricants in a well-ventilated area only. Avoid prolonged breathing of the fumes or contact with the skin.

4. Use extreme care in handling the cores to minimize soil disturbance. Keep the cores vertical at all times. Do not lay them down.

5. Seal cores carefully following procedures given in Section 3.3.4.

6. Store cores in a shaded area.

7. Do not overheat paraffin in field paraffin warmer to prevent it from catching on fire -- heat only until the paraffin is melted.

8. Use caution when handling gasoline and filling paraffin warmer. Gasoline is extremely flammable. No smoking: Keep away from running engines and electrical equipment; leave tank about 5% empty to allow for expansion of gasoline; dispose of gasoline-soaked rags or towels properly (do not put in kit box).

3.2 FUNCTIONAL DESCRIPTION

3.2.1 Introduction

This section provides a functional description of the impact corer and the theory of operation. Refer to Figure 3.1 or to the Illustrated Parts Breakdown, Figures 3.40 and 3.41, Section 3.7, for part identification.

3.2.2 Tool Function

The tool's function is to take a relatively undisturbed soil sample from the seafloor that is of high enough quality to be tested in a laboratory to obtain geotechnical data.

3.2.3 Functional Sequence

The impact corer is lowered to the seafloor with a line. The divers swim down with the tool. To operate the corer, it is held upright at the seafloor. The diver pushes the core tube into the soil as far as possible by the handles. When the diver can no longer push the tube in by hand, the impact hammer is used to drive the core tube in to either the full 30 inches or to a point where the tube is no longer penetrating. The hammer should be used as little as possible since its use disturbs the soil sample. The core tube is then pulled out of the seafloor, and the bottom end of the core tube is capped as soon as it clears the seafloor. The core must be kept vertical to prevent disturbance. When the core is brought to the surface, it is properly capped, sealed, and labeled. The core is then ready to go to a geotechnical laboratory for testing.

3.2.4 Component Function and Theory of Operation

3.2.4.1 Core Guide Frame. The guide frame provides support for the coring process and acts as a guide to help in taking a core vertically in the seafloor. The frame also supports the piston rod and keeps the piston at the seafloor surface while the core is being taken. The diver's fins can be placed under the small flaps at the bottom of the frame and used to steady the corer during operation.

3.2.4.2 Core Tube. The core tube is used to take the sample and for storing and

shipping the sample. The core tube is clear Lexan, an extremely tough plastic, that allows the divers to see how much sample is in the core tube while they are still on the bottom. The top of the core tube has gripping grooves cut into it for the lock ring in the head nut to grip. The bottom end of the core tube has a beveled edge to cut into the seafloor. When properly capped and sealed, the tube is a very good storage container for the sample. Tight fitting caps are provided to seal the core tube. These caps must be taped on and, when possible, sealed with paraffin.

3.2.4.3 Head and Head Nut. The head and head nut hold the core tube in the frame. Inside the nut is a lock ring and an O-ring that grip the core tube. Above the nut is a valve screen that allows water to escape as the core tube fills with soil.

3.2.4.4 Handles. The handles are used to push the core tube into the seafloor and to pull the filled core tube out.

3.2.4.5 Impact Hammer. The impact hammer is used to hammer the core tube into the seafloor when it can no longer be pushed in by the handles. The hammer should be used as little as possible since hammering causes disturbance in the sample. The hammer can also be used to hammer the core tube back out of the soil if it is stuck. But again, the hammer should be used as little as possible.

3.2.4.6 Piston Rod. The piston rod goes down the middle of the core tube; the piston is screwed on to the lower end. The handle at the top of the piston rod sticks out the top of the frame and holds the piston at the level of the seafloor surface during the coring operation.

3.2.4.7 Piston. The piston is a round piece of PVC plastic with a U-packing seal around the outer diameter. This piston is held at the seafloor surface while the core tube is pushed past it to take a core. The piston creates a suction in the core tube that helps in taking a core with the least amount of disturbance. The piston is unscrewed from the piston rod and stays in the core tube at the top of the sample to help prevent disturbance during handling and shipping.

3.2.4.8 Rod Clamp. The rod clamp tightens against the piston rod and holds the piston still. After the core has been taken, the clamp must be tightened to hold the piston stationary. If the piston moves up, it will pull some of the soil in the tube with it and create a break in the core. A core with a break in it has limited use for laboratory analysis. If the piston moves down, it will push soil out the bottom of the tube.

3.3 ASSEMBLY, OPERATION, AND CORE HANDLING

3.3.1 Introduction

This section explains step-by-step the assembly, operation, and core handling for the impact corer. Before the corer is used to take a core, the amount of sample needed for the geotechnical testing should be determined (see Section 3.10). One of the most important points to remember from this section is the need to handle the cores with care to minimize disturbance.

3.3.2 Assembly

The steps to assemble the impact corer are given below. Be sure to apply the proper lubricant as the parts are being put together. Refer to the Illustrated Parts Breakdown (Figures 3.40 and 3.41) to identify the parts.

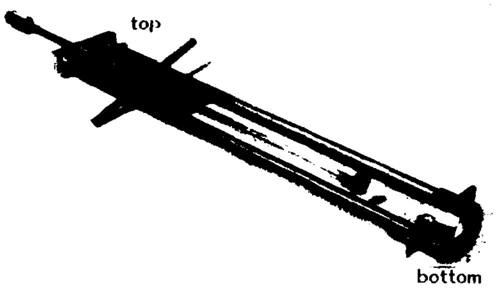
ASSEMBLY STEPS:

1. Put the piston rod in the small hole in the center of the rectangular top of the guide frame (Figure 3.3a).

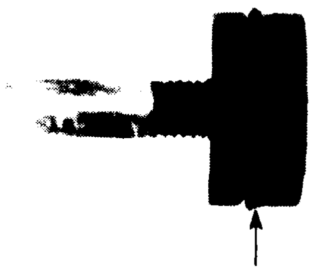
2. Slide the impact hammer onto the bottom of the piston rod in the guide frame (Figure 3.3a).

3. Slide the head cnto the piston rod from the bottom after the hammer (Figure 3.3a) with the threads toward the bottom.

4. Screw piston onto bottom of piston rod; lubricate U-packing seal on piston with silicon grease. Note the proper placement of the U-packing seal on the piston in Figure 3.3b.



(a)



(b)

Figure 3.3. Assembling impact corer.

5. Push core tube onto piston and push up until top of tube seats up in head. Be sure that the grooved end of the core tube is the one seated in the corer head. The grooves provide a gripping surface for the lock ring in the head nut (Figure 3.4).

6. Place a lock ring inside the head nut.

7. Put the head nut on over the core tube and push up to the head; lubricate threads with Never-Seize.

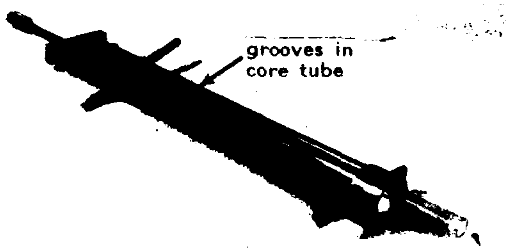


Figure 3.4. Inserting core tube into impact corer.

8. Screw head nut onto head and tighten head nut with spanner wrench (Figure 3.5).

9. Push piston rod down so that piston is at bottom of core tube and push the hammer and head up to the top of the frame. When all parts are up tight against each other, screw in the rod clamp until it locks the piston rod in place.

10. Attach spanner wrench to corer by tying it on with a line or place with other items to be taken down by divers.

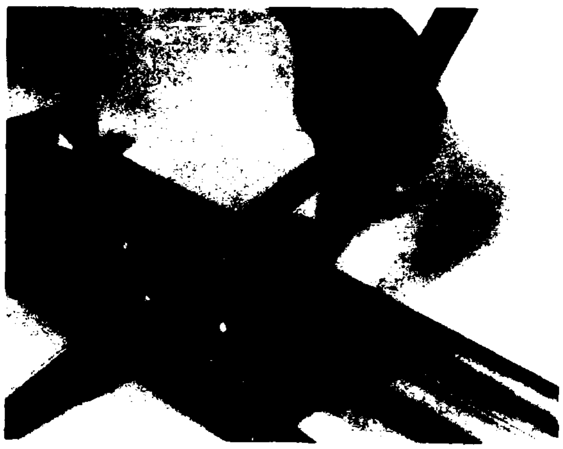


Figure 3.5. Using spanner wrench to tighten head nut.

11. Tie a line onto the piston corer frame for lowering tool to the seafloor. The line should be longer than the water depth at the coring location.

12. Assemble the caps, spanner wrench, and grease pencil the divers will need to take down with them.

3.3.3 Operation

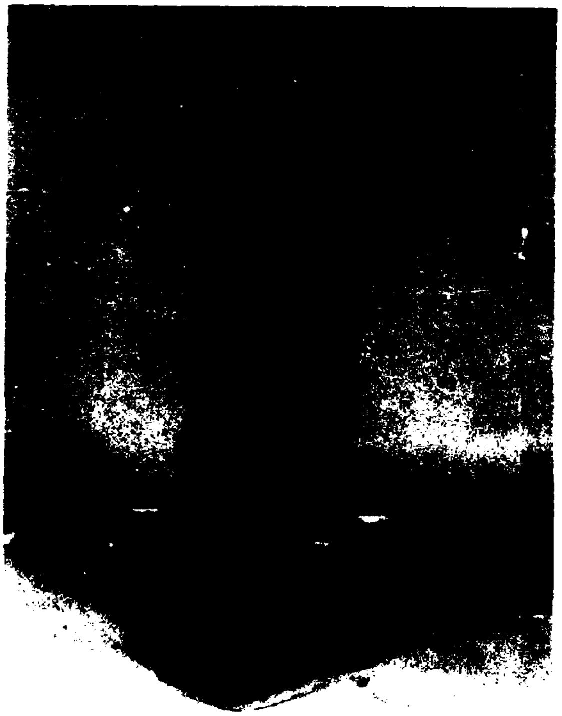
There are two methods of taking cores with the impact corer: (1) cores can be taken and brought to the surface one at a time, or (2) up to six cores can be taken before the divers surface. There is a core cage (Figure 3.6) in the kit that will hold six cores and the divers can change core tubes underwater. Before the divers try this, they should have some experience with changing the core tubes. If the divers are going to change core tubes on the bottom, they should also take a pair of pliers or channel locks that will fit around the tube to grip the piston and hold it while the piston rod is unscrewed. The pistons should be greased and placed in the bottom of the core tubes before they are taken down. The core tubes (uncapped) should be filled with water and placed in the cage. Plenty of caps should be taken downwith the divers also. If the divers are going to be working out of a small craft, the core cage or a large bucket can be used to stand the cores up in until they can be properly cared for. It is important that the cores be kept upright (vertical) until they are properly cared for (see Section 3.3.4.).

OPERATION STEPS:

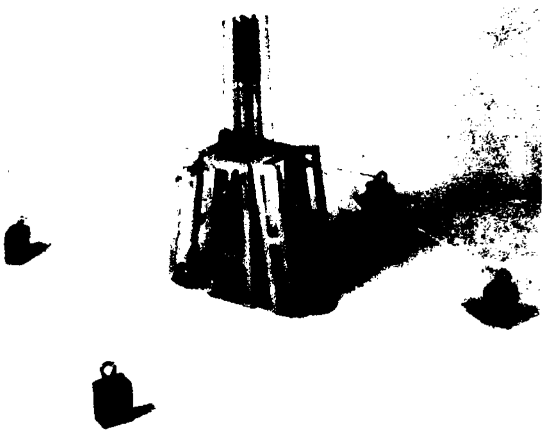
1. When divers are ready (have caps, grease pencil, and necessary tools), lower the impact corer to the seafloor. The divers should swim down with the corer. If the cage is being used, it should be lowered now also (Figure 3.6a).

2. If the core cage is used, it should be set up before taking the first core. The cage should be upright and stable. The weights in the bottom can be placed to help stabilize the cage (Figure 3.6b).

3. Place impact corer upright on seafloor (Figure 3.7a). Diver #1 stands with fins under



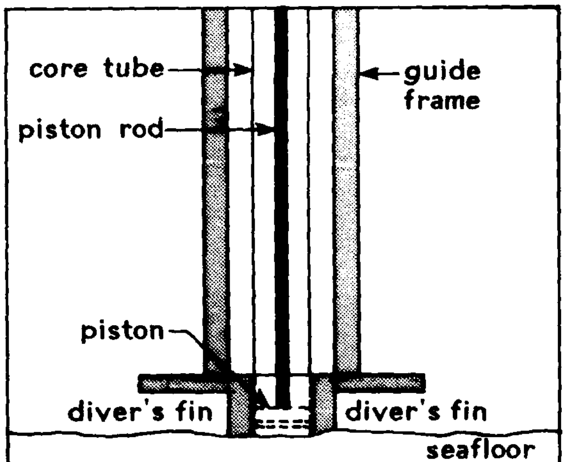
(a)



(b)

Figure 3.6 Core cage.

(a)



Diver's fin under flaps keeps piston on top of seafloor; otherwise, corer sinks in and top 3 inches of seafloor are not sampled.

(b)

Figure 3.7. Setting up to take core.

flaps on corer (Figure 3.7b). Diver #2 should help steady core guide frame and be in a position near the bottom of the corer with a cap ready. Diver #2 should also check to see that the piston is at the bottom of the tube.

4. Diver #1 unscrews the rod clamp (Figure 3.8).

Figure 3.8. Loosening rod clamp.

5. Diver #1 pushes the core tube in using the handles until it will not go any farther (Figure 3.9). Gently twisting the tube will help ease its way in. Too much twisting will disturb the sample.

6. Use the impact hammer to drive the core tube the rest of the way into the seafloor (Figure 3.10). If using the hammer does not succeed in driving the core tube in any further, you may have hit a rock; move over and try again. Be sure to clean out the core tube and reposition the piston at the bottom of the core tube before starting to take another core.

Figure 3.9. Pushing core tube in.

Figure 3.10. Hammering core tube in.

7. When the core tube is fully embedded in the soil, screw in the rod clamp to lock the piston in place (Figure 3.11). This is a very important step in recovering an undisturbed sample. If it is not locked, the piston will move and the suction will pull apart the core. If possible, use the grease pencil to mark on the core tube the level of the seafloor and the height of the core in the tube while embedded. Label these marks after capping the core tube bottom. This is useful information for determining the density of sands.

Figure 3.11. Tightening rod clamp.

8. With the piston rod locked in place, diver #1 pulls the core out of the seafloor (Figure 3.12) while diver #2 gets ready to place a cap on the bottom of the core tube as soon as it clears the bottom (Figure 3.13).

9. Diver #2 may need to slip a hand under the bottom of the core tube (Figure 3.14) and then cap it (Figure 3.15).

Figure 3.12. Pulling core out.

Figure 3.13. Cap ready.

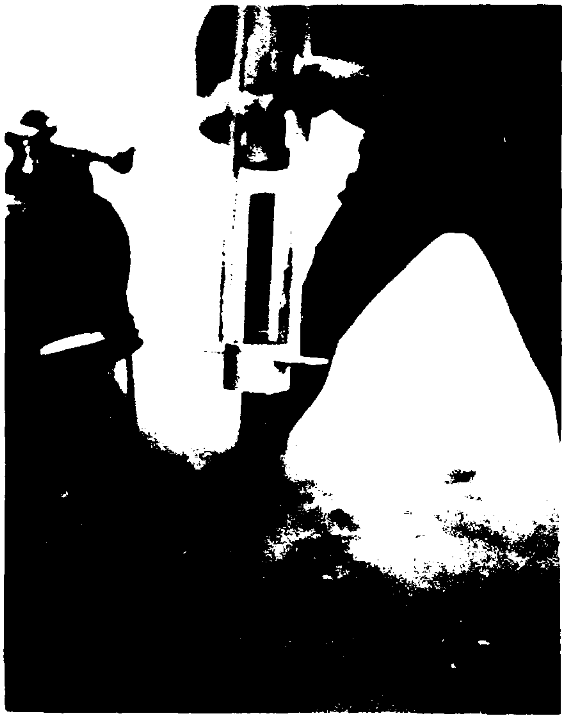


Figure 3.14. Hand on bottom of core.

Figure 3.15. Putting cap on bottom of core.

10. If the core is to be brought to the surface now, signal on the line for the corer to be pulled up. The divers should swim up with the corer and guide the core, which will be hanging out the bottom of the corer, keeping it vertical, and hold the cap on the bottom of the tube (Figure 3.16). The whole corer should be brought back on deck and the core removed from the corer.

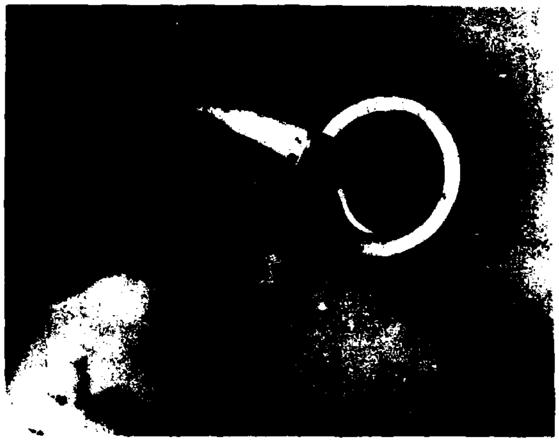


Figure 3.17. Cleaning out head nut.

Figure 3.16. Swimming up with corer and core.

Figure 3.18. Marking level of soil.

11. If operating out of a very small craft, take the spray bottle to clean the head and head nut threads after removing a core and before inserting a new core tube (Figure 3.17).

12. Use the grease pencil to identify the core immediately. Also, mark the level of the top of the retrieved sample on the core tube (Figure 3.18). Write TOP on the top cap. Be

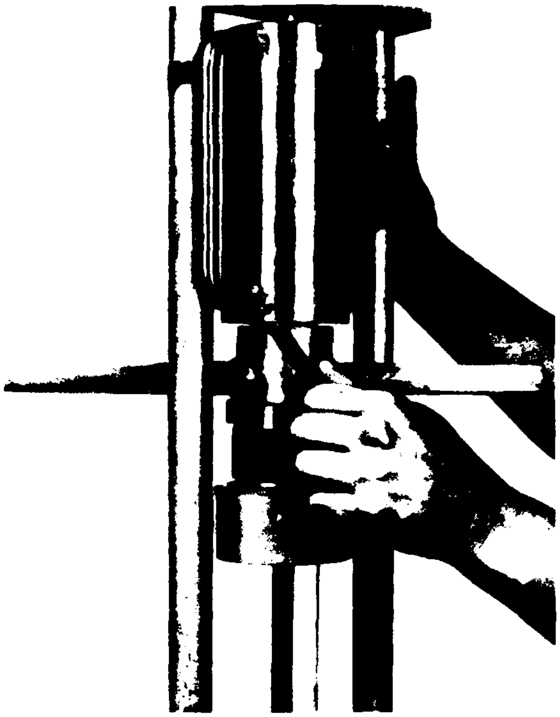


Figure 3.19. Loosen rod clamp.

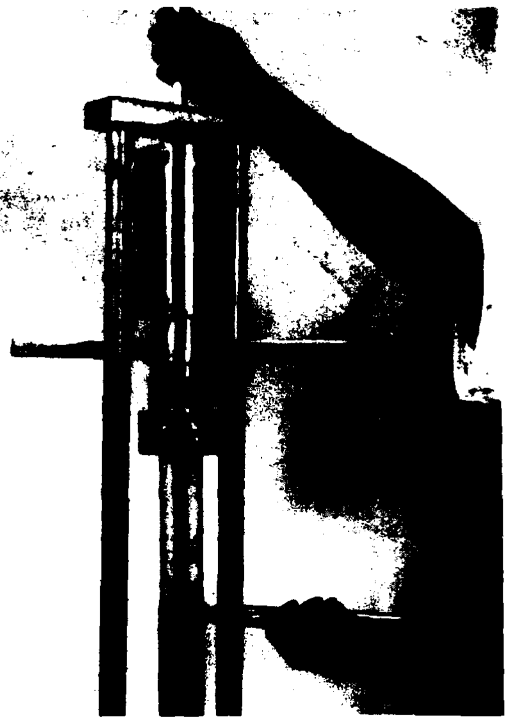


Figure 3.20. Unscrewing piston rod.

careful not to rub off any of the grease pencil marks.

13. See Section 3.3.4, Core Handling, for instructions on what to do with the core after it is recovered.

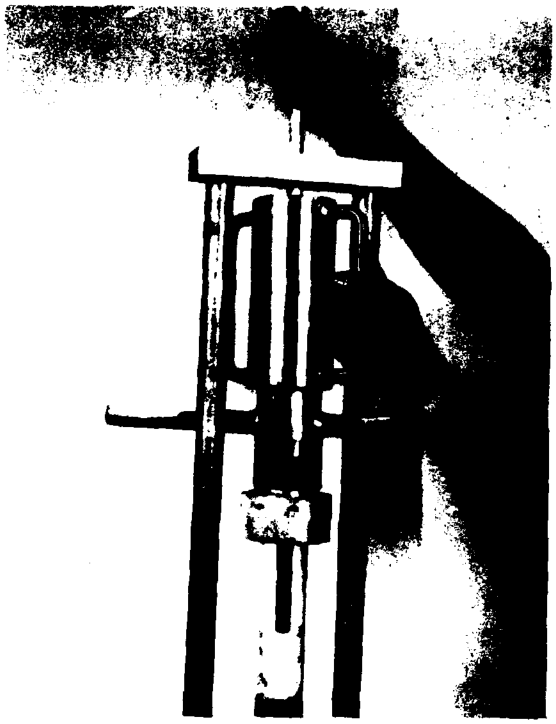
14. If the core is to be changed underwater, steps 15 through 21 should be followed.

15. After capping the bottom of the core tube, hold the corer upright and grip the piston through the tube with the pliers. Unscrew the rod clamp first (Figure 3.19) and then unscrew the piston rod from the piston (Figure 3.20), leaving the piston in the tube on top of the soil. Remove the piston rod (Figure 3.21a), holding onto the impact hammer since it is free to fall when the rod is removed (Figure 3.21b).

16. Use the spanner wrench to unscrew the head nut. Gently pull the core tube out of the head (Figure 3.22). Keep the core tube vertical.

17. Place a cap on the top of the core tube and place the core tube in the core cage.

18. Use a grease pencil to mark the top surface of the soil sample (Figure 3.18). Draw the line all the way around the tube. This is very important for the density test that may be done at the laboratory later. The soil will settle in the core tube with time, so it is important to get the length marked as soon as possible after it comes out of the seafloor. Label all lines marked on the core tube.



(a)

(b)

Figure 3.21. Removing piston rod and hammer.

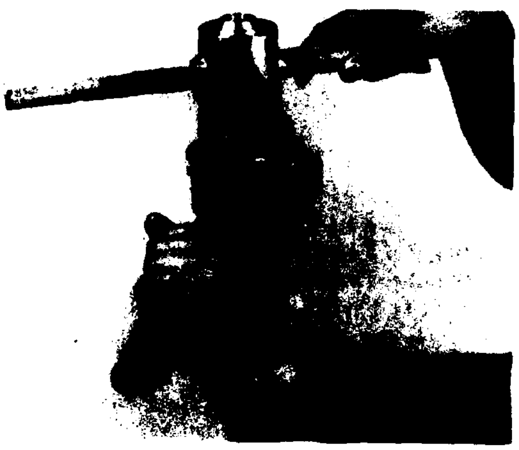


Figure 3.22. Removing head nut with spanner wrench.

19. Use the grease pencil to write the data ID number on the core tube. Be careful not to accidentally wipe the grease pencil off when handling the core. Also put an arrow pointing to top of core. Label the top cap "TOP."

20. Insert a new core tube in the corer, screwing the piston rod onto the piston, and then screwing the head nut on (and tighten with spanner wrench).

21. When the new core tube is in place, push all the parts together tight so that the piston is at the bottom of the core tube. Tighten the rod clamp until ready to take the next core.

3.3.4 Core Handling

How the core is handled after it is brought to the surface is very important. This is where a lot of the disturbance in the soil sample happens. The following steps should

be followed closely in order to provide good quality cores to the geotechnical laboratory for testing. A core data sheet (Figure 3.23) should be filled out while the core is being capped and sealed. From the example situation in Chapter 2, an example data sheet has been filled out and is shown in Figure 3.24.

CORE HANDLING STEPS:

1. Keep the core tube vertical until the top has been sealed properly.

2. As soon as possible after the core is taken, the length of the sample in the core tube should be measured (Figure 3.25). If this is not possible, mark the top of the sample on the core tube with a grease pencil. When this length or mark is measured later, record this on the data sheet (see Figure 3.24 for an example). Keep the core tube vertical.

3. If a data ID has not been marked on the core tube yet, use a grease pencil to mark it.

4. Open up the core shipping box and prepare it for the core samples.

5. Push the piston down with the detached piston rod towards the top of the sample gently, leaving a small (about 1/4-inch) gap between the piston and the sample (Figure 3.26). Get the piston close to the top of the sample without disturbing the sample. There is a small hole in the piston for water to escape.

6. Use the hacksaw to cut off the top of the core tube just above the piston (Figure 3.27). Do this carefully and try not to shake up the sample. There should be almost no air space at the top of the core between the piston and the cap. Save the top piece cut off to fill out the core tube shipping box. An alternate method would be to not cut off the core tube and fill the core tube above the piston with seawater so the sample will not dry out. Then go to step 9. If the core tubes are not cut off, they can be reused later.

7. Use a knife to smooth the rough edges of the core tube (Figure 3.28).

8. Use a paper towel to clean and dry off the core tube and the cap at the top (Figure 3.29).

9. Place a cap over the top end of the core tube. Insert one of the 6-inch wires under the side of the cap to let any trapped air escape (Figure 3.30). Push the cap down tight on the top of the core tube.

10. Use black electrical tape to tape the cap onto the tube. Start the tape on the cap and stretch the tape as it is being wrapped around the tube and cap (Figure 3.31a). Cover the cap and about 1 inch of core tube with about a dozen wraps of tape (Figure 3.31b). Label cap "TOP" and mark side with an arrow pointing upward (Figure 3.31c).

11. Now gently lay the core tube down horizontally; try not to let it roll around. It is all right to lay it down now since the piston at the top of the sample will prevent the soil from moving.

12. Carefully remove the bottom cap. If the soil is wet enough or loose enough to run out, tip the end of the core tube up.

13. Use a knife to scrape the soil out of the cap and place it back in the bottom of the core tube (Figure 3.32). Try to get as much soil as possible back in the core tube. The correct weight of the soil and the original length of the sample are very important for determining the density of the soil in the laboratory.

14. Wash out the bottom cap and dry it with paper towels, getting all the soil out of the cap.

15. Clean off the outside of the core tube with paper towels (Figure 3.33). It is very important to get all the soil off the core tube. If only one grain of soil is stuck between the cap and the core tube, it will provide a path for water no matter how tightly it is taped and sealed. Water will find that path and drain out of the sample. When the sample drains, it is of limited use for geotechnical testing.

16. Push the clean cap onto the clean core tube bottom. Again, use a 6-inch wire to let trapped air escape and push the cap on tight.

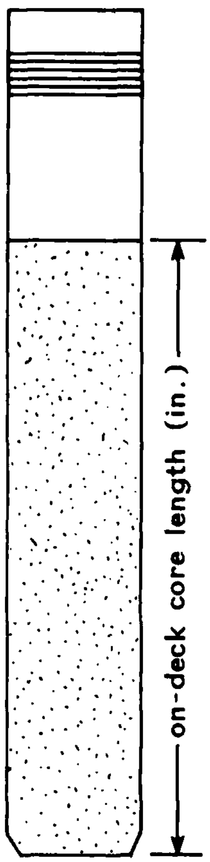
Page

CORE DATA SHEET

Project: ______________________________

Date: ______________________ Time: ______________________

Divers: ______________________________



Site + Core ID	On-Deck Core Length (in.)	Corer Penetration Depth Full|3/4|1/2|?	Corer Penetration Easy/Hard

Observations: ______________________________

____

____

____

____

____

____

Problems: ______________________________

____

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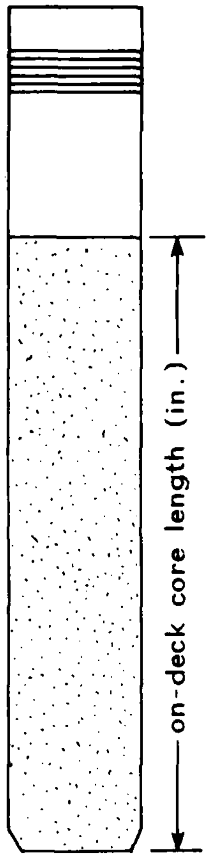
Figure 3.23. Core data sheet.

CORE DATA SHEET

Page

Project: Special Test Facility
Date: 12 Jul 85 Time: 0855
Divers: Wright, Larabee



Site + Core ID	On-Deck Core Length (in.)	Corer Penetration Depth Full|3/4|1/2|?	Corer Penetration Easy/Hard
AA-1	28½"	full	no hammer easy
AA-2	28¼"	full	easy
AB-5	27⅛"	full	easy
AB-6	28⅛"	full	"
AC-9	26"	full	"
AC-10	25"	full	"
AD-13	26⅞"	"	"
AD-14	27½"	"	"
AE-17	28	"	"
AE-18	27⅝	"	"

Observations: Seafloor is silty, visibility poor, no hammer needed to get full penetration of core tube, lots of small seashells

Problems: Hit some small rocks while taking cores

Figure 3.24. Core data sheet filled out for example in Chapter 2.

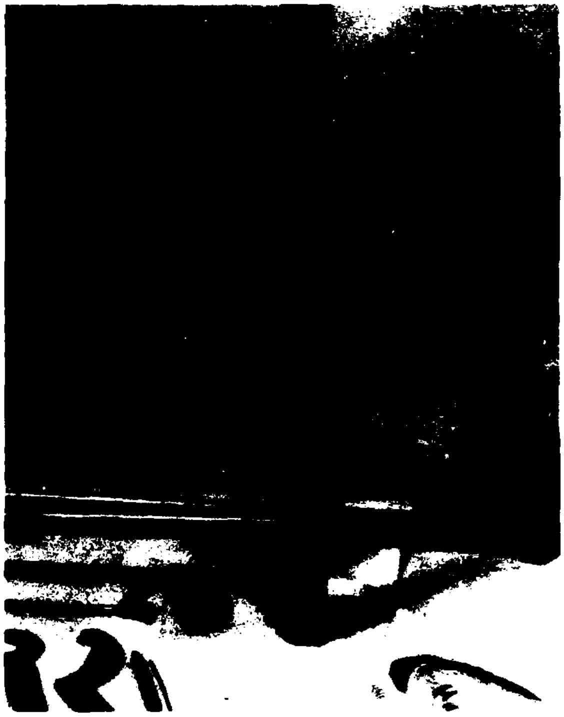


Figure 3.25. Measuring core.

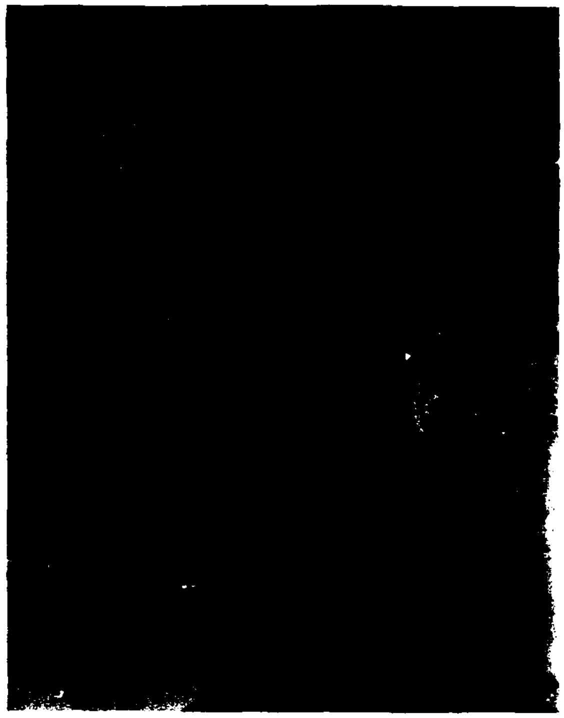


Figure 3.26. Pushing piston down.

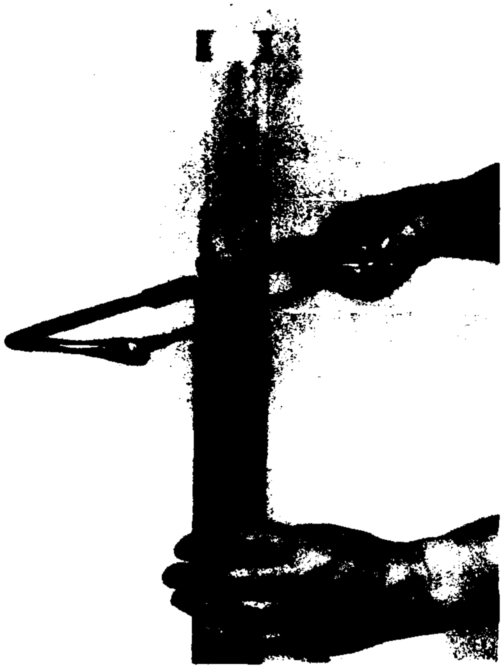


Figure 3.27. Cutting off core tube.

Figure 3.28. Cleaning cut edge of core tube.

Figure 3.29. Cleaning core tube.

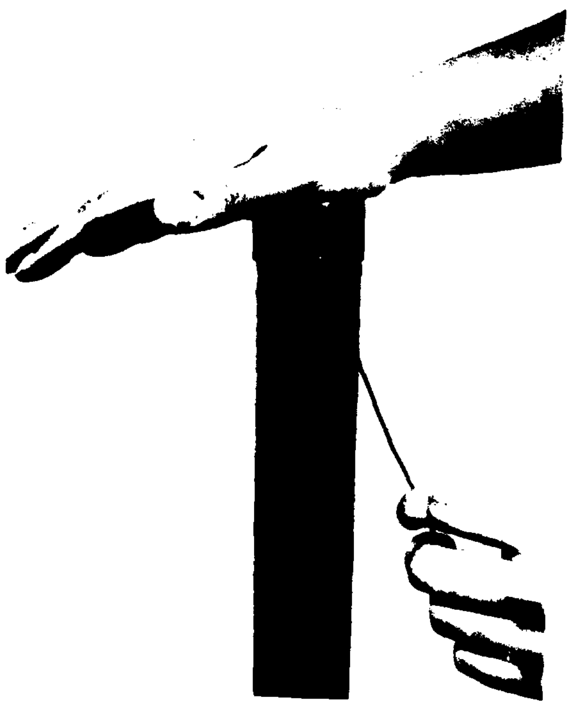
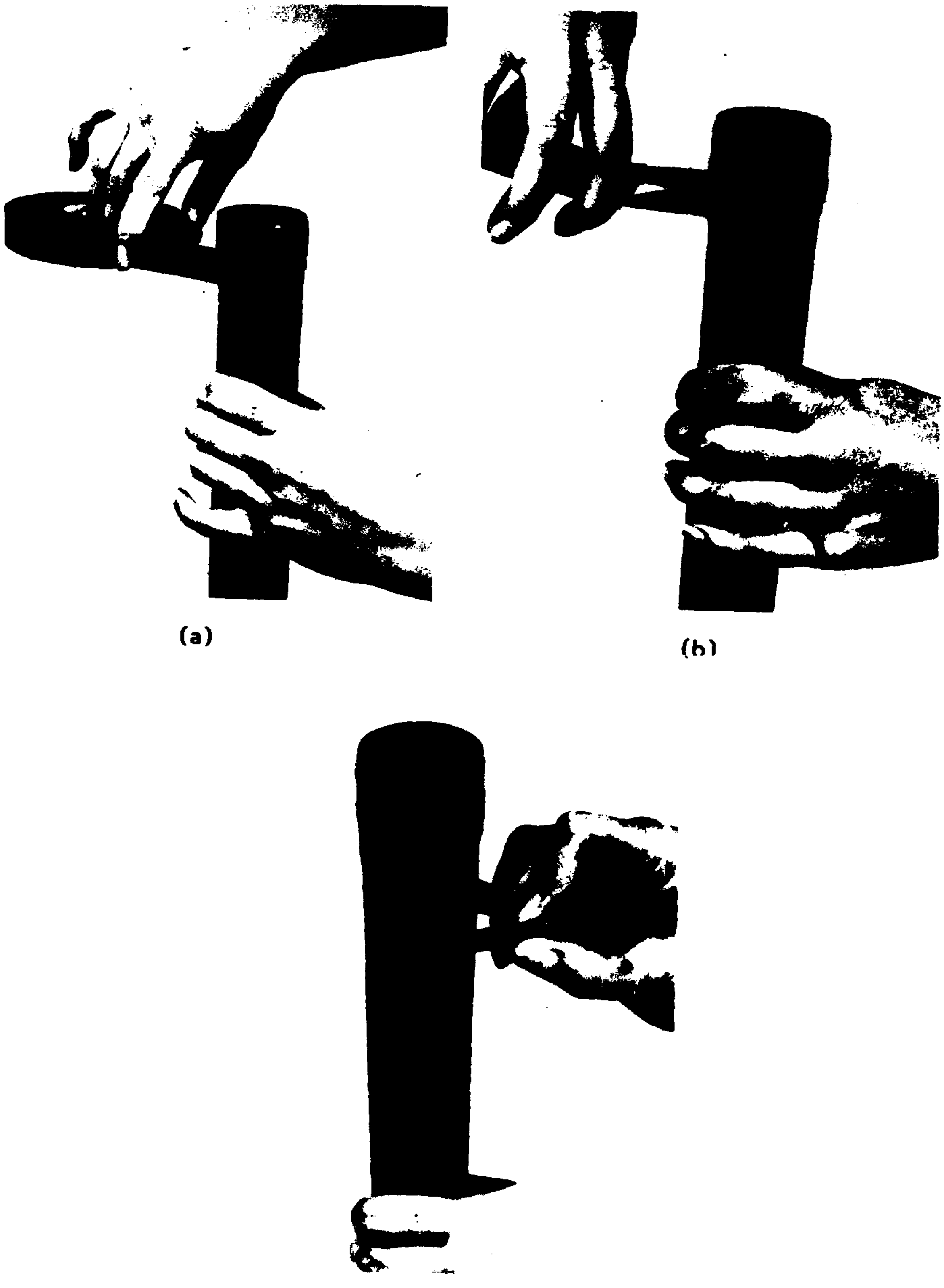


Figure 3.30. Capping core.



(a) (b) (c)

Figure 3.31. Taping core.

Figure 3.32. Bottom of core and bottom cap.

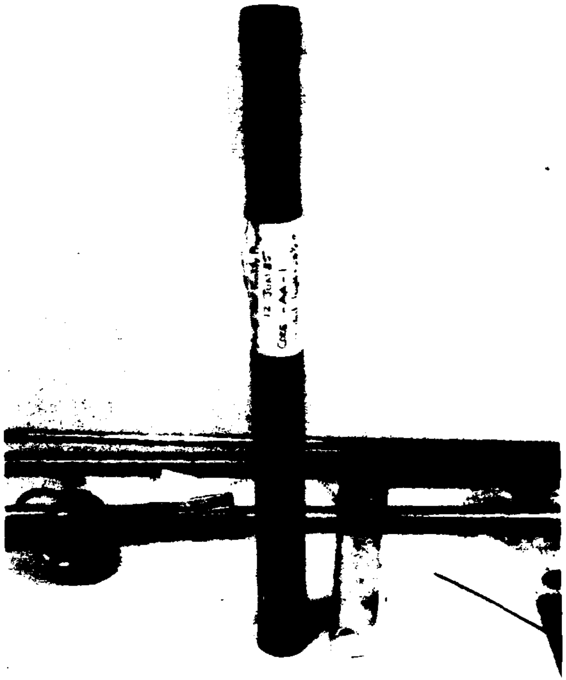
Figure 3.33. Clean cap for cleaned up bottom of core tube.

17. Use black electrical tape to tape the bottom cap on as you did the top cap.

18. Write the core data ID on a 3x5 card (Figure 3.34a), place the card in a plastic sample label bag, and tape it to the side of the core tube (Figure 3.34b).

19. If possible, let cores stand, top up for a few hours to see if there is any water lost. If water is found leaking from one of the cores, redo the bottom cap following steps 11 through 17.

(a)



(b)

Figure 3.34. Core labeling.

20. When all the cores have been capped and taped for the day, set up the paraffin warmer. Gasoline can be used as the fuel. Set the pail of paraffin in the top and warm until just melted. Do not let the paraffin get too hot. When it has just reached the point where it is melted, dip the ends of the capped and taped core tubes in the paraffin (Figure 3.35). Let the sealed ends harden.

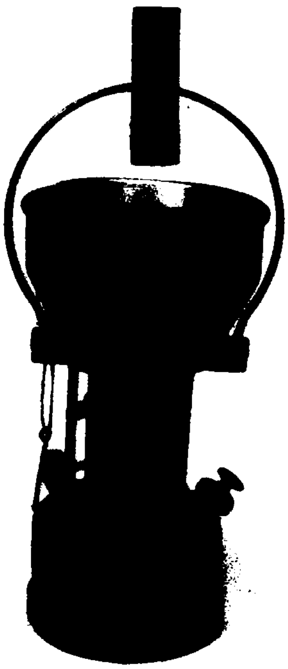


Figure 3.35. Field parafin warmer.

21. Place the sealed and labeled core in the shipping box. Place the cut off top section of the core tube to fill out the space or use terry towels if core tube is lost. This will prevent the core from moving during shipping (Figure 3.36).

22. Store the cores out of direct sunlight and as far away from vibrations as possible.

23. When labeling the shipping box for shipping, identify the contents as ocean sediments, rather than as soils so they will not need to be inspected by the Department of Agriculture.

Figure 3.36. Core shipping box with sealed core.

3.3.5 Summary Instruction Sheet

The above instructions for the assembly and operation of the impact corer and for the handling of the cores have been condensed to one page with an illustrated parts breakdown on the back side (Figure 3.37). A copy of this page can be laminated and kept in the kit box for quick field reference. These instructions are very brief and the assembly, operation, and core handling sections in the manual should be read in order for the one page instructions to make sense.

3.4 SCHEDULED MAINTENANCE

3.4.1 Introduction

Maintenance of the impact corer is performed before and during storage, before use, and after use. If proper maintenance is done immediately after tool use, little or no maintenance will be needed during storage or before another use of the tool. Therefore, maintenance procedures for after use will be presented here. Maintenance procedures for storage and before use are the same as those after use with a few exceptions, which will be noted.

IMPACT CORER INSTRUCTION SHEET)
(See Operation and Maintenance Manual for complete instructions)

I. SAFETY PRECAUTIONS:

1. Be careful with hammer; do not get fingers between hammer and top of corer head or top of frame; hold onto hammer when removing piston rod so it won't fall.
2. Seal cores carefully following procedures in manual; use extreme care in handling cores to prevent disturbance; store in shaded area away from vibration.
3. Do not overheat parafin in field warmer; heat only until parafin melts otherwise it may catch on fire.

II. ITEMS DIVERS NEED:

1. Impact corer with core tube in and lowering line attached
2. Core tube caps

If taking several cores at once:

3. Core gage with core tubes in and lowering line attached
4. Spanner wrench
5. Slip-joint pliers
6. Grease pencils

III. TOOL ASSEMBLY:

1. Put piston rod in corer frame.
2. Slide hammer and then corer head onto piston road.
3. Screw piston onto piston rod; check U-packing seal for proper direction (see manual).
4. Slide core tube over piston and seat ribbed end of core tube in head, tighten head nut.
5. Push piston to bottom of core tube and tighten rod clamp.
6. Attach lowering line to guide frame.

IV. TOOL OPERATION:

1. Stand corer up on bottom; put fins under flaps.
2. Loosen rod clamp to loosen piston rod.
3. Push core tube into seafloor using handles as far as possible.
4. Use hammer to further embed corer; use sparingly since it disturbs sample.
5. Tighten rod clamp to clamp piston on top of sample in core tube.
6. Pull corer out by handles; use hammer upward if difficult to remove.
7. Cover bottom of core tube with hand when it emerges; cap with core tube cap.

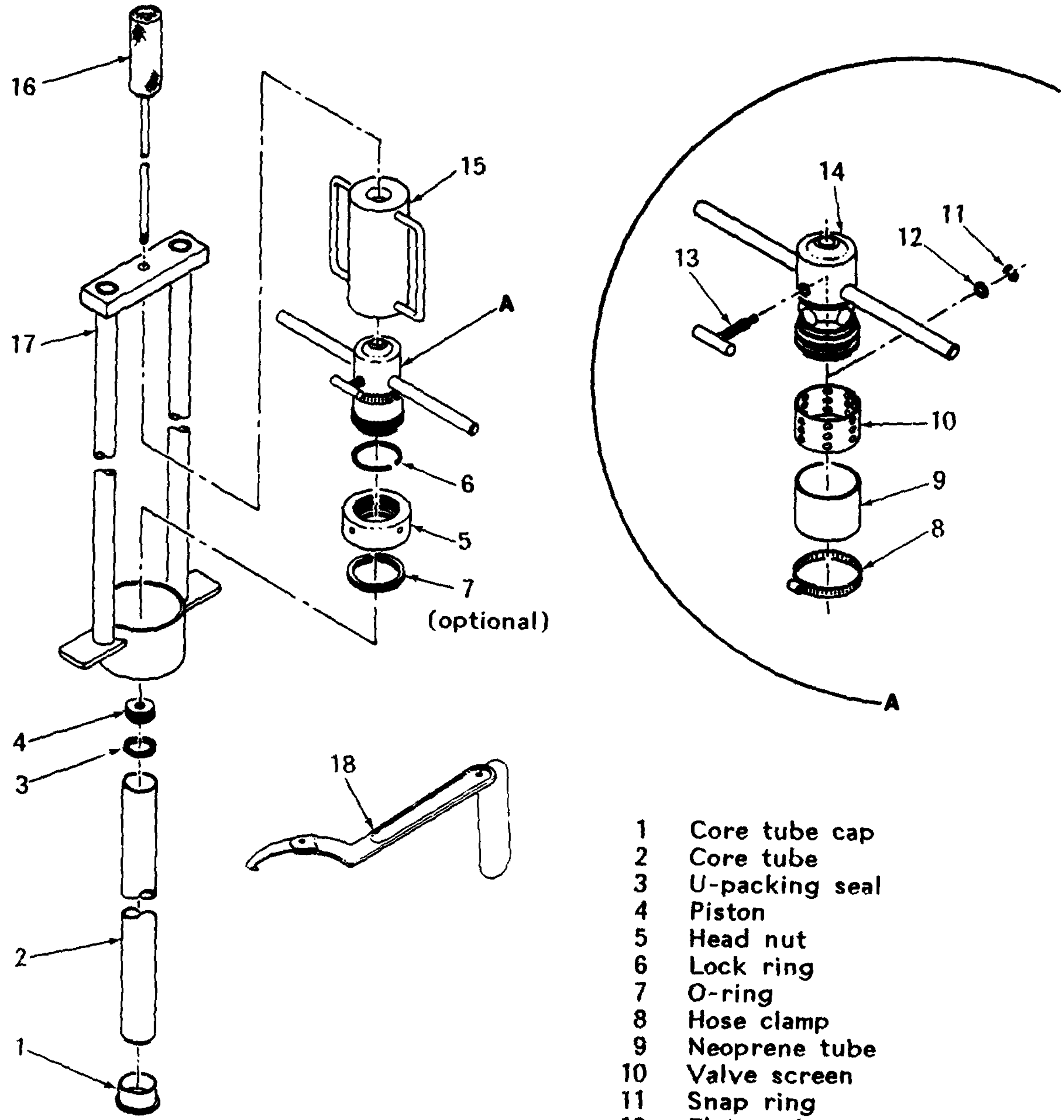
If taking another core:

8. Loosen rod clamp.
9. Grip piston with slip-joint pliers and unscrew piston rod leaving piston in core tube.
10. Loosen head nut with spanner wrench and remove cor : tube (hold onto hammer).
11. Store core vertically in core cage, cap top.
12. Insert new core tube in corer.
13. Clean tool according to manual instructions when finished.

V. CORE SAMPLE OBTAINED:

1. Core samples, properly capped and sealed, that can be used for laboratory analysis.
2. Mark length of sample in core tube and measure, record and on data sheet.
3. Push piston down to top of sample.
4. Cut core tube off just above piston with hacksaw.
5. Clean and dry top of core tube.
6. Cap core tube and seal with electrical tape, mark TOP on cap.
7. Lay core down (tip bottom end up).
8. Remove bottom cap, push as much soil as possible from cap back into bottom of core tube.
9. Clean cap and outside of core tube.
10. Recap bottom, seal with electrical tape.
11. Attach label to cover.

Figure 3.37. Summary instruction sheet - impact corer.



1 Core tube cap
2 Core tube
3 U-packing seal
4 Piston
5 Head nut
6 Lock ring
7 O-ring
8 Hose clamp
9 Neoprene tube
10 Valve screen
11 Snap ring
12 Flat washer
13 Rod clamp
14 Head
15 Impact hammer
16 Piston rod
17 Core guide frame
18 Spanner wrench

IMPACT CORER

3.4.2 After-Use Maintenance

The required maintenance steps for the impact corer after use are listed below. Proper maintenance of the tool after use in saltwater will prolong its usefulness.

AFTER-USE MAINTENANCE STEPS:

1. Remove core tube from tool, if it is still in. Unscrew all parts and break down tool.

2. Wash all parts with freshwater, use bucket and wire brush to clean threaded parts and to remove soil, and then dry tool (Figure 3.38).

Figure 3.39. Lubricating threads.

Figure 3.38. Clean head threads.

Figure 3.40. Wiping down with rust preventative.

3. Apply Never-Seize to all threads (Figure 3.39).

4. Apply a coat of a rust preventative, such as LPS-3, to all surfaces of the tool (Figure 3.40).

5. Store all parts separately. Do not screw head nut back on to head for storage. Do not leave a piston screwed onto the piston rod.

6. Place tool parts back into kit box.

7. Note kit contents lost or consumed and tool repairs needed.

3.4.3 Storage Maintenance

The steps for storage maintenance are the same as steps 3 through 6 in after-use maintenance with the addition of the following steps:

7. Check to see if the tool has been cleaned and stored properly after field use.

8. Check supplies in tool kit against list in Section 3.8 and restock as needed.

3.4.4 Before-Use Maintenance

The steps for before-use maintenance are the same as those for during storage maintenance.

3.4.5 Paraffin Warmer Maintenance

The manufacturer's instructions for the paraffin warmer are included in Figure 3.41.

3.5 TROUBLESHOOTING

3.5.1 Introduction

This section presents some of the common problems that might occur in the operation of the impact corer. The troubleshooting procedures are listed in Table 3.1. See Section 3.6 for corrective maintenance procedures.

3.6 CORRECTIVE MAINTENANCE

3.6.1 Introduction

This section describes specific corrective maintenance for field maintenance of the impact corer.

3.6.2 Maintenance Procedures

3.6.2.1 Core Tube and Head Nut. If the core tube is not staying in the head during the coring process, it is probably due to soil in-between the head and the nut. Remove the head nut and clean it thoroughly using the wash bottle or a bucket and wire brush if possible. Remove all soil particles. Apply a coat of lubricant, such as Never-Seize. Clean off the top of the core tube. Check to see if the gripping grooves are cut into the top of the core tube. Check to see if a lock ring is in place inside the head nut.

3.6.2.2 Piston. If the corer is not recovering a good core, check to see if the U-packing seal around the piston is in good shape; if this seal is not good, a suction will not be maintained and a good core will not be retrieved. Look for cuts or tears in the seal or look to see if it is old and brittle. Replace the seal with a new one.

3.6.2.3 Valve Screen. Remove the hose clamp and take the neoprene tubing off the head. Clean the screen and head well, using a wire brush and freshwater. Reassemble, replacing the neoprene tubing or hose clamp if necessary. Refer to Section 3.7 to identify parts.

3.7 ILLUSTRATED PARTS BREAKDOWN

3.7.1 Introduction

This section contains t[illegible] illustrated parts breakdown (IPB) for the impact corer. The IPB consists of a parts list (Table 3.2) and illustrations (Figures 3.42 and 3.43). The parts in the list are indexed to the illustrations, and the indexing reflects the disassembly sequence. More information can be found in Section 3.8 (TOOL KIT) and Section 3.11 (PROCUREMENT).

3.7.2 Parts List

The parts list (Table 3.2) includes all major components, assemblies, and detail parts for the impact corer. Each illustrated part shown disassembled in Figures 3.42 and 3.43 is assigned an index number. Parts shown as assemblies are listed (whenever possible) with reference to the figure number that shows the part disassembled.

3.7.2.1 Figure and Index Number Column. The figure and index number column list is in numerical order. The figure and index number of each part is shown on the corresponding illustration.

3.7.2.2 Reference Designation Column. The reference designation column will remain blank because there are no designated electrical or electronic parts for the impact corer.

MAINTENANCE

The *Unique Furnaces* have been tested thoroughly, and are guaranteed to give perfect satisfaction. If given the proper care and attention they will give lasting service and satisfaction.

Faulty burning may be due to one or several of the following causes:

1. *Improper Fuel.* Gasoline containing tetraethyl lead or other lubrication compounds should never be used. For most efficient results we recommend using a good grade of water white low test gasoline or such brands that contain no harmful compounds.

2. *Choked Nozzle.* If the hole in the nozzle gets choked, use only the cleaning needle supplied with the furnace to dislodge the dirt and carbon. Insert the needle carefully so as not to enlarge the hole.

3. Worn-out washers in filler plug and pump should be replaced immediately to insure against leakage.

4. *Leaking Pump Valve.* If the pump plunger rises of its own accord after inserting pressure in the tank, this denoted a defective spring or cork washer in the check valve. The furnace should not be used until these parts have been replaced.

5. Occasionally oil pump plunger leather through hole in cap and at piston. If the leather washer dries out, it should be spread out on the piston in the opposite direction and well greased.

6. *Cleaning Burner.* After a long period of use, the burner should be cleaned thoroughly. This is done by removing it from the tank and taking off all the accessories and plugs. Pull the wire gauze out from the main channel, and insert a stiff piece of wire in all the channels to loosen the carbon, and then flush with water. Replace all parts tightly, and do not fail to grease the threads with soft soap before screwing the burner back on the tank. It is always advisable to replace the nozzle and wire gauze with new ones every time the burner is cleaned.

NOTE: If your furnace gets out of commission and cannot be made to function after following the above directions, send it to us charges prepaid, and we will put it in first class working order at nominal cost.

UNIQUE FURNACES

DIRECTIONS FOR USE

FILLING: Remove filler plug, fill container with a good grade of water white gasoline and replace filler plug. Tighten with rod or wrench to avoid air leakage. Be sure plug air release screw is tightly closed.

PRE-HEATING: Proper heating of the burner is most essential in order to produce the best results. After making certain the regulating valve on the burner is shut off, give the pump a few strokes. Fill preheating pan underneath burner about 3/4 full with alcohol or gasoline. If fuel overflows, wipe tank dry. Ignite. When the fuel in the pan is nearly consumed -- not before -- open the regulating valve on the burner slightly and the flame will ignite the escaping gas.

REGULATING: After furnace has been working a short time, more pressure should be inserted in the tank until the flame is of the required size. Opening and closing the valve regulates the flame, but the valve should not be throttled down so low that an ineffective yellow flame results. As pressure in tank decreases, it should be increased by giving a few strokes of the pump.

EXTINGUISHING: Close regulating valve completely and then loosen the air release screw in the filler plug to release all the pressure from the tank. Close screw.

IMPORTANT: Container should never be exposed to outer heat. Furnace should never be moved during pre-heating process. Never tighten pack nut while burner is hot.

Figure 3.41. Manufacturer's instructions for field test parafin warmer (soil test).

Table 3.1. Troubleshooting - Impact Corer

Problem	Probable Cause	Corrective Action
Core tube pulls out of head	1. Lock ring and head nut not gripping tube	1. Remove head nut and clean surfaces; apply lubricant. See Section 3.6.2.1.
		2. Check to see if core tube is in top up and gripping grooves are cut in core tube.
Core tube not full after full penetration of seafloor	1. Piston not in proper position at start of coring	1. Push piston to bottom of tube, push hammer and head to top of guide frame, and lock piston rod in place with rod clamp.
	2. Suction not maintained in core tube	2. Check U-packing seal for condition and valve screen for plugging (see 3.6.2.2 and 3.6.2.3).
	3. Soil type will not allow a full core to be obtained	3. No corrective action possible.
Core tube will not move	1. Piston rod locked in place	1. Unscrew rod clamp.
Corer will not fully penetrate seafloor	1. May have hit rock or other buried object	1. Move corer over, empty out tube, and start over.
	2. Soil may be too stiff for capability of corer	2. No corrective action possible.

Table 3.2. Parts List - Impact Corer

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
3.42-0		82-7-1F 82-7-2F	1	IMPACT CORER ASSY INSTL (FOR NHA SEE FIG ____)	80091	REF	
3.42-1		1-3/4 SC-R	2	CAP, CORE TUBE	96760	1	
3.42-2		82-7-1F-13	2	TUBE, CORE (LEXAN)	80091	1	
3.42-3		8405-0131-N4182	2	SEAL, U-PACKING (NIRILE)	30781	1	
3.42-4		82-7-1F-11	2	PISTON	80091	1	
3.42-5		82-7-2F-14	2	NUT, HEAD	80091	1	
3.42-6		82-7-2F-13	2	RING, LOCK (CRES 316)	80091	1	
3.42-7		2-327-N602-70	2	O-RING	02697	1	
3.43-8		6832	3	CLAMP, HOSE, 2-1/4-IN.-DIA	81646	1	
3.43-9		82-7-2F-6	3	TUBE, 2-1/4-ID x 2- x 1/32-IN.-THICK (NEOPRENE)	80091	1	
3.43-10		82-7-2F-15	3	SCREEN, VALVE (CRES 316)	80091	1	
3.43-11		MS 1663-25SS	3	RING, SNAP	80091	1	
3.43-12		AN960 C 4016	3	WASHER, FLAT	80091	1	
3.43-13		82-7-2F-2	3	CLAMP, ROD	80091	1	
3.43-14		82-7-2F-4	3	HEAD (6061-T6)	80091	1	
3.42-15		82-7-2F-3	2	HAMMER, IMPACT	80091	1	
3.42-16		82-7-1F-3	2	ROD, PISTON	80091	1	
3.42-17		82-7-1F-2	2	FRAME, CORE GUIDE	80091	1	
3.42-18		5472A5	2	WRENCH, SPANNER	39428	1	

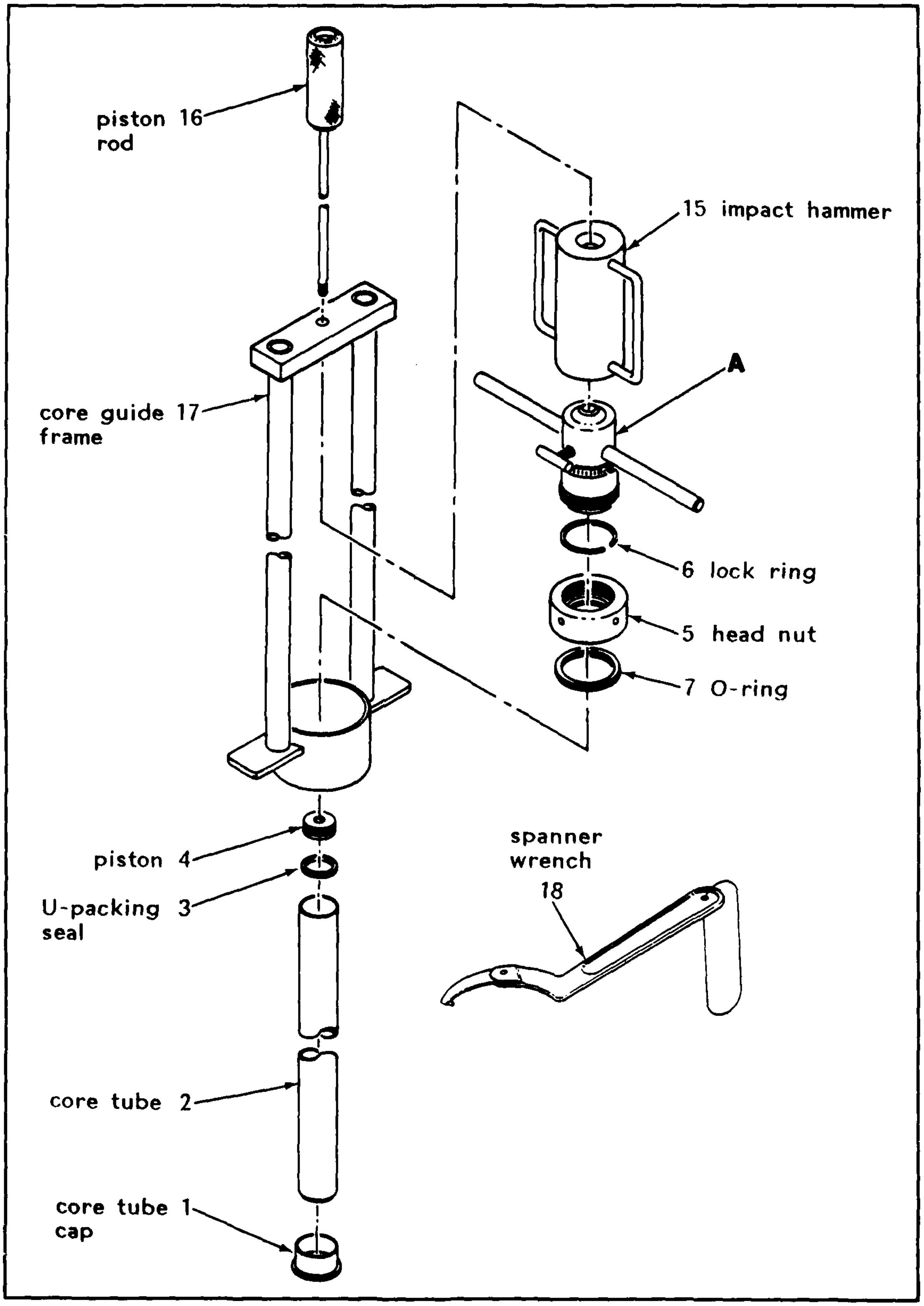


Figure 3.42. Impact corer assembly installation.

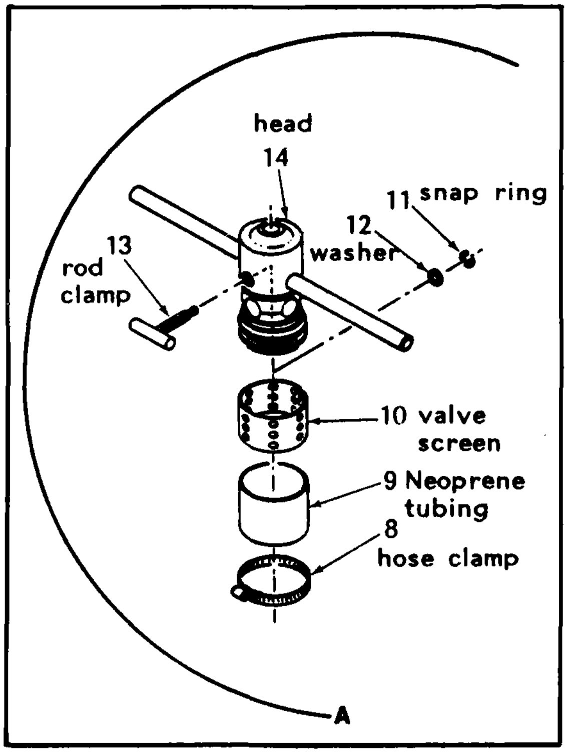


Figure 3.43. Impact corer assembly installation.

3.7.2.3 **Part Number Column.** The part number column lists the manufacturer or Government part number for all parts shown in the applicable drawings. An entry of COML designates that the part or material is generally available through a variety of commercial sources or vendors. This column may also contain a NO NUMBER entry, indicating that the part has no applicable part number but is identified for procurement by the data in the description column.

3.7.2.4 **Indent Column.** The numbers 1 through 3 in the indent column show the relationship of parts and subassemblies to assemblies and/or installations. For any given figure, a number 1 indent item is the top level of an assembly or installation, and a number 3 indent is the lowest level of disassembly.

3.7.2.5 **Description Column.** The description column contains descriptions of all parts listed in the applicable drawings. Modifiers are included to identify the characteristics of a particular item. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference. A cross-reference appears both in the listing where the assembly is first described and in the listing in which the assembly is broken down. In the latter, the abbreviation REF appears in the quantity per assembly column. Abbreviations in the description column are generally in accordance with MIL-STD-12C and/or as noted in the list of abbreviations and acronyms.

3.7.2.6 **Manufacturer's Code Column.** The manufacturer's code column lists numbers identifying the suppliers of the parts. Table 3.3 lists both suppliers and codes, which are also available in the Federal Supply Code for Manufacturers, Cataloging Handbooks H4-1 and H4-2.

3.7.2.7 **Quantity Per Assembly Column.** The quantity per assembly column contains one of the following entries: a numeral indicating the quantity of the item used only at the indicated location or the abbreviation REF, indicating that the required quantity is listed on the figure referenced in the description column.

3.7.2.8 **Used-On Code Column.** This column will remain blank because there are no used-on codes applicable to this parts list.

3.7.3 Abbreviations and Acronyms

The abbreviations and acronyms listed in Table 3.4 appear in the parts list and in the text of this manual. Abbreviations used in the text may be in lower case letters, initial capitals with lower case letters, or all capitals. Abbreviations used in the parts list are in all capitals. The abbreviations and acronyms listed in Table 3.4 are in all capitals for consistency.

Table 3.3. List of Manufacturers' Codes, Names, and Addresses

Code	Name and Address
02697	Parker-Hannifin Corporation Seal Group, O-Ring Division 2360 Palumo Drive Lexington, KY 40509
30781	Parker-Hannifin Corporation Packing Division 2220 S. 3600 W. Salt Lake City, UT 84119
31995	Jenkins Bros. 101 Merritt 7 Norwalk, CT 06851
35708	Textron Canada LTD Homelite-Terry Division 180 Labrosse Avenue P.O. Box 1800 Pointe Claire, Que Can H9R 4R6
39428	McMaster-Carr Supply Company P.O. Box 4355 Chicago, IL 60680
75336	Kingston F.C. Company 1007 N. Main Street Los Angeles, CA 90012
80091	Naval Facilities Engineering Command Washington, DC 20370
80094	Smith Herman H., Inc. 1913 Atlantic Avenue Manasquan, NJ 08736
81646	Ideal Corporation Sub of Parker-Hannifin Corporation 1000 Pennsylvania Avenue Brooklyn, NY 11207
95760	Protective Closures Company, Inc. 2150 Elmwood Avenue Buffalo, NY 14207
98773	Soiltest, Inc. 2205 W. Lee Street Evanston, IL 60202

Table 3.4. List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AP	Attaching Part
ASSY	Assembly
ASTM	American Society for Testing and Materials
COML	Commercial
CONN	Connector
CRES	Corrosion Resistant Steel
DEG	Degree
DIA	Diameter
EXT	Extension
FEM	Female
FIG	Figure
FT	Feet
GA	Gage
GAPL	Group Assembly Parts List
ID	Inside Diameter
IN.	Inch/Inches
INSTL	Installation
IPB	Illustrated Parts Breakdown
L	Long
MSPT	Miniature Standard Penetration Test
NHA	Next Higher Assembly
NPT	National Taper Pipe (Thread)
OD	Outside Diameter
PT	Point
PVC	Polyvinyl Chloride
REF	Referenced
SQ	Square
SS	Stainless Steel
ST	Street
STD	Standard
SUBASSY	Subassembly
THD	Thread

3.8 TOOL KIT

3.8.1 Introduction

This section explains the function of the tool kit and lists the contents and the purpose of each item. Procurement information is given in Section 3.11. An Illustrated Parts Breakdown for the tool is given in Section 3.7.

3.8.2 Tool Kit Function

The impact corer tool kit is designed to be self-sufficient in the field with the exception of a source of freshwater and gasoline fuel for the paraffin warmer. The tool kit is packaged in one box. This box is of plywood construction, 4 feet long by 2 feet wide by 2 feet tall for a total cube of 16 ft^3. The complete kit weighs 265 pounds. The kit contains all the spare parts, repair parts, and supplies to take 50 cores (Figure 3.44). An accessory to the kit is the shipping box designed to hold 12 cores. The number of shipping boxes needed for each job should be estimated beforehand. If not enough are available, more should be built (see Section 3.11 for drawings).

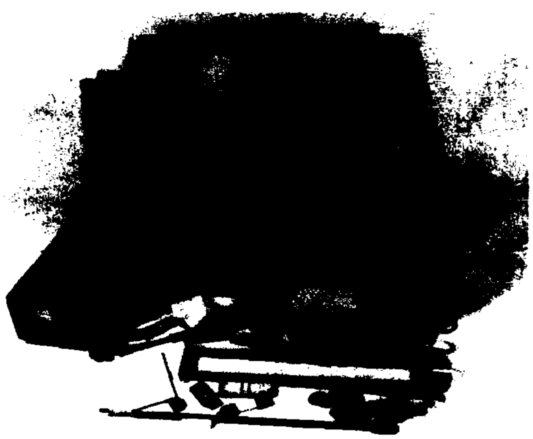


Figure 3.44. Impact corer kit contents.

3.8.3 Tool Kit Contents

A list of the tool kit contents is shown in Table 3.5. The kit contents are listed as they are placed in the kit box, from bottom (Figure 3.45) to top (Figure 3.46) and from back to front. Table 3.5 (with Figures 3.45 and 3.46) can be laminated and placed in the lid of the kit box and used as a check list and packing guide. A brief explanation of the function of each item is given in Table 3.6.

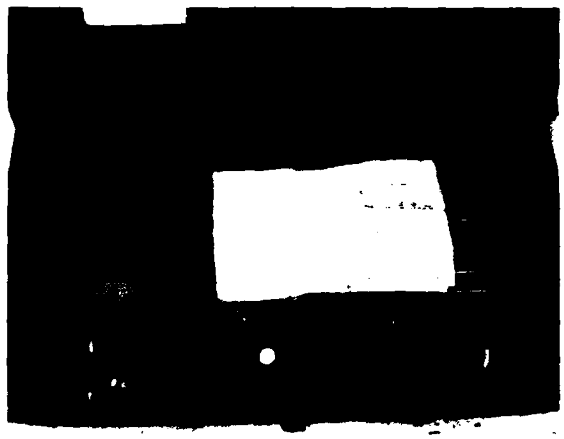


Figure 3.45. Bottom of kit box.

Figure 3.46. Top of kit box.

Table 3.5. List of Contents - Impact Corer Kit

Item	Kit Contents No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier	Manufacturer/Supplier Part Number
1	1	Kit box - impact corer	3.50		83-27-1F		Local carpenter shop	
2	1	Field paraffin warmer					Soiltest	L40
3	1	Warmer cleaning needle					Soiltest/Unique Mfg. Co.	
4	1	Paraffin block					Soiltest	LT101
5	50	Core tubes	3.47	3.42-2	82-7-1F	10	Local plastics/machine shop	
6	100	Core tube caps	3.47	3.42-1	82-7-1F	13	Caplug Div, Protective Closure	1-3/4 SC - red
7	1	Terry towel package						FSN 7920-00-823-9772
8	100	Core data sheets	B-5 or 3.23					
9	5	Geo. site survey planning sht	B-1					
10	5	Summary sheet	B-2					
11	5	Site data sheet	B-3					
12	5	Site sketch sheet	B-4					
13	5	Geo. tool fail. & inad. rpt	B-10					
14	1	Plastic bucket (4 qt)						FSN 7240-00-061-1163
15	1	Metal paint pail (2 qt)					Local supplier	
16	20	Plastic bags						FSN 8105-00-655-8285
17	1	Spray bottle for LPS-3						FSN 8125-00-488-7952
18	1	Core cage + 4 lead weights	3.49		83-28-1F			
19	1	LPS-3 (1 gal - bulk)					Local supplier	
20	2	Hacksaws						FSN 5110-00-289-9651
21	1	Core guide frame	3.47	3.42-17	82-7-1F	4,5,6,7	Local machinist	
22	1	Piston rod	3.47	3.42-16	82-7-1F	8,9	Local machinist	
23	1	Spray bottle - water						FSN 8125-00-488-7952
24	100	3x5 cards						FSN HD-7530-00-247-0318
25	50	Plastic label bags						FSN 8105-00-756-2710
26	5	Rolls - electrical tape						FSN 5970-00-419-4291
27	12	Black china markers						FSN 7520-00-223-6672
28	2	Tape measures - 10 ft						FSN 5210-00-054-1011
29	1	Never-Seize						FSN 8030-00-180-6187
30	10	Wire pieces, 6 in.					Local	
31	12	Lead pencils, #1						FSN 7510-00-286-5757
32	2	Erasers						FSN 7510-00-323-8788
33	1	Spanner wrench		3.42-18	82-7-1F	18		
34	1	Wire brush, stainless steel						FSN 7920-00-269-1259
35	1	Slip-joint pliers - 10 in.						FSN
36	1	Hacksaw blades - pkg						FSN 5110-00-277-4591
37	1	Corer head	3.48	3.42 & 43-8-14	82-7-2F	4-10,15,16	Local machinist	
38	2	Head nut	3.48	3.42-5	82-7-2F	14	Local machinist	
39	1	Impact hammer	3.47	3.42-15	82-7-1F	11,12	Local machinist	
40	5	Locking rings	3.47	3.42-6	82-7-1F	13	Local machinist	
41	2	Neoprene tubes	3.48	3.43-8	82-7-2F	6	Local supplier	
42	2	Hose clamps	3.48	3.43-9	82-7-2F	16	Local supplier	
43	50	Pistons	3.47	3.42-4	82-7-1F	11	Local supplier/machinist	
44	40	U-packing seals	3.47	3.42-3	82-7-1F	12	Local supplier/Parker.	8405-0131-N4182
45	2	Silicone grease tubes						FSN 6850-00-880-7616
46	1	Summary instruction sheet	3.37					
47	1	List of contents	Table 3.5					

Table 3.6. Function of Kit Contents

Item	Description	Function in Kit
1	Kit box	Contain contents of kit, shipping container
2	Field paraffin warmer	Melt paraffin for sealing cores
3	Warmer cleaning needle	Clean nozzle on paraffin warmer (see instructions Figure 3.41)
4	Paraffin block	Seal cores
5	Core tube	Take, seal, and ship soil sample in
6	Core tube cap	Cap ends of core tube
7	Terry towels	Clean up core tubes for sealing; clean and wipe tool with rust preventer
8	Core data sheets	Record information about the cores
9	Planning sheet	Guide for planning geotechnical site survey (see Chapter 2)
10	Summary sheet	Summarize results at end of a survey (see Chapter 2)
11	Site data sheet	Record data location coordinates for site survey (see Chapter 2)
12	Site sketch sheet	Lay out sketch of site and mark and label data locations (see Chapter 2)
13	Failure & inadeq. report	Report field problems with the geotechnical diver tools or kits (see Chapter 2)
14	Plastic bucket	Take bulk soil samples; hold water for cleaning tool
15	Metal pail	Melt paraffin in
16	Plastic bags	Store bulk soil samples in
17	Spray bottle - LPS-3	Apply bulk LPS-3
18	Core cage	Holds six cores underwater or in small boat; spread weights for stability
19	LPS-3 (bulk)	Rust preventative/lubricant for metal items
20	Hacksaws	Cut core tube to proper length for shipping
21	Core guide frame	Support and guide for taking core (see Section 3.2.4.1)
22	Piston rod	Holds piston in place (see Section 3.2.4.6)
23	Spray bottle - water	Clean soil from corer parts when changing core tubes
24	3x5 cards	Label for core - include date, data location, length of core (see Section 3.3.4)
25	Plastic label bags	Protect core label on 3x5 card and attach to core tube
26	Electrical tape	Tape core tube caps and labels onto core tubes
27	Black china markers	Mark core tube with soil level, "TOP"; write information on 3x5 card
28	Tape measure	Measure length of core in core tube
29	Never-Seize	Lubricate threaded parts to prevent seizing and galling
30	Wire pieces - 6 in.	"Burps" core tube caps when putting on core tube
31	Lead pencils	Fill out data sheets, planning, summary, site survey, etc. sheets
32	Erasers	Use on data sheets, planning, summary, etc.
33	Spanner wrench	Loosen and tighten head nut
34	Wire brush	Clean up tool; remove soil from threads
35	Slip-joint pliers	Grip piston through core tube while unscrewing piston rod
36	Hacksaw blades	Refills for hacksaws
37	Corer head	Holds core tube and aligns piston rod (see Section 3.2.4.3)
38	Head nut	Grips core tube so it can be pulled out of seafloor (see Section 3.2.4.3)
39	Impact hammer	Help drive core tube into seafloor (see Section 3.2.4.5)
40	Locking ring	Tightens around core tube when head nut is tightened
41	Neoprene tube	Acts as a flapper valve for water escaping core tube while taking core
42	Hose clamp	Holds neoprene tube in place
43	Piston	Creates suction in core tube to help take undisturbed core (see Section 3.2.4.7)
44	U-packing seal	Creates suction around piston
45	Silicone grease	Lubricate U-packing seal; do not use anything else; other products deteriorate seals
46	Summary instruction sheet	Reminder of tool use in field
47	List of contents	Guide for packing kit and replacing kit contents

3.9 SHIPPING AND STORAGE

3.9.1 Introduction

The impact corer kit is designed to be stored in the kit box. The contents of the kit were selected to allow the kit to be shipped by commercial and military truck, ship, and aircraft. Shipping regulations change over time, so current regulations should be checked before shipping the tool kit.

3.9.2 Storage

Contents of the kit shall be prepared for storage by ensuring that all metal parts have been cleaned and are sprayed with a rust preventative, such as LPS-3. The gasoline tank on the field paraffin warmer should be cleaned and purged. This can be done by purging first with diesel fuel and then with air, CO_2, or nitrogen; repeat this twice. Cap can tightly.

3.9.3 Shipping

Current shipping regulations should be checked before shipping the impact corer tool kit. Only two items in the impact corer kit require special care for shipping: the lubricant/rust preventative LPS-3 and the field paraffin warmer. Special packaging and permits can be avoided by using LPS-3 in bulk form. It is the aerosol packaging of this substance that requires it to have special packaging and permits. The gasoline can on the field paraffin warmer should be purged as described in Section 3.9.2, Storage. By using LPS-3 in bulk form and purging the gasoline can on the paraffin warmer, the kit can be classified as a COMBUSTIBLE LIQUID, which requires no special shipping or certification requirements. The box must only be labeled "COMBUSTIBLE LIQUID".

The shipping container for the cores should be labeled "OCEAN SEDIMENTS" rather than "soil" to avoid the possibility of inspection by the Department of Agriculture during the shipping process. The core container should also be marked to be handled with care.

For shipping, the cube and weight of the packaging are given below:

Item	Cube (ft^3)	Weight (lb)
Impact corer kit	16	265
Core shipping box (empty)	3	32

3.10 DATA ANALYSIS

3.10.1 Introduction

This section will present the type of testing possible on the cores, the kind of data that can be obtained, how the data can be used, and how much sample is required to do the testing. This section is not intended to be a text on geotechnical testing of marine soils. There are references listed at the end of the manual that provide that type of information. The purpose of the section is to help in determining how many cores are needed from one location to have enough soil available to do the testing needed on that soil. Some tests can be done on all types of soils, but some tests are for specific soils only. The information will be divided into three segments: all soils, cohesive soils, and cohesionless soils.

3.10.2 Testing for All Soil Types

The types of laboratory tests that can be run on all soils are given below.

1. *Color*: The wet and dry soil color can be determined using a Munsell color chart. Color changes can sometimes indicate layers that may have different properties. A very small sample (a teaspoonful) is used in determining the color and it can come from part of the core used for another test.

2. *Grain size:* The grain size and percentage of each size can be determined by a miniature mechanical sieve test and the smaller clay sizes by a hydrometer test. Soil used for these tests cannot be used for any other test. Usually there is enough in one core do this test along with most of the other basic tests, if there are only one or two soil layers in the core.

3. *Water content:* The water content can be determined by weighing and then drying and weighing again a sample of soil from the core. This test takes a small amount of the core (about a 1-inch length of the core tube) and it is usually done on samples from several different levels within the core. The dry sample can be used for specific gravity tests.

4. *Specific gravity:* The specific gravity of the soil grains can be determined using a special testing machine for that purpose. The same sample that was used for the water content test can be used.

5. *Density*: Density tests can be run on all soils, but the methods used for cohesive and cohesionless soils are different and require different uses of the core; therefore, density testing will be discussed under the sections on cohesive and cohesionless soils.

6. *Carbonate and organic carbon content*: Organic and carbonate content may be determined with a Leco induction furnace using procedures describe in its instruction manual. The weight of salts should be subtracted from the total uncorrected dry sample weight.

3.10.3 Testing for Cohesive Soils

The types of tests that should be run only on cohesives soils are listed below.

1. *Density*: Density in cohesive soil can be measured by cutting sections out of the core tube and measuring the volume of the tube section and then the weight of the soil in the section. This soil can also be used then to run the water content test. This might take a section of core tube 1 to 2 inches in length. This will still leave plenty of sample for some other tests.

2. *Vane shear strength:* How much of the core is needed to do this test depends on what depths in the seafloor the data are needed. If data are needed every 3 to 6 inches, a separate core will be needed just to do these tests. If the data are only needed at one or two points in the 30-inch core, then there is still plenty of sample to do the other tests.

3. *Atterberg limits:* There are five different Atterberg limit tests, with two of them being the most common. These tests determine plasticity of the soil, which is one way to categorize the soil. To do these two tests, a section out of the core about 2 to 3 inches in length is needed. It is a good idea to do vane shear tests and Atterberg limit tests at the same level; therefore, a separate core may be needed from the same location to have enough soil.

4. *Triaxial tests:* Triaxial tests are run to determine the strength of the soil. If triaxial tests are needed, at least three cores should be taken just for this test. The results of this test are especially sensitive to disturbance, so the core must be of very good quality.

3.10.4 Testing Cohesionless Soils

The types of tests that should be run only on cohesionless soils are listed below.

1. *Density*: Density in a cohesionless soil is difficult to obtain. The core taken with the impact corer can provide a fairly good value for the in-place density by taking an average density over the entire length of the core. If the core tube is cut into sections as in the density test performed on cohesive soils, the granular cohesionless soil falls out so readily the test cannot be completed. Instead, with the cohesionless core, the entire volume occupied by the sample should be determined and then the weight of the entire soil sample in the core tube measured. Doing this disturbs the sample, so any other tests requiring an undisturbed core will need another core from the same location. To obtain density measurements at intermediate levels, cores can be taken with progressively shorter core tubes, such as a 6-inch tube, a 12-inch tube, an 18-inch tube, a 24-inch tube, and then the full 30-inch tube. The shorter ones (6- and 12-inch) may be pushed in by hand (then cap top to create suction), depending on the soil; the others should be inserted using the corer.

2. *Direct shear:* This test can determine the strength of the cohesionless soil in terms of the soil's angle of internal friction, or

friction angle. A large amount of soil is needed for this test, approximately the amount in three or four cores. Either several cores should be taken or, since the sample is reconstituted for the test, a large bulk sample can be taken with a bucket and then stored in a plastic bag (labeled and sealed) if the soil is not layered. If the soil is layered, more cores will be needed to have enough of each soil layer for separate testing.

3.11 PROCUREMENT INFORMATION

3.11.1 Introduction

All the necessary information to procure the impact corer diver tool, the impact corer kit box, and all its contents is contained within this manual. The information can be found in the following locations:

Table 3.5	List of Contents - Impact Corer Kit
Section 3.7	Illustrated Parts Break down - Impact Corer
Section 3.11.2	Purchase Description
Section 3.11.3	Manufacturers and Suppliers
Section 3.11.4	Drawings
Appendix B	Data Sheets

Table 3.5 can be used as a master list to procure anything in the kit. Within the table is information such as drawings, manual figure numbers, part numbers, and manufacturers.

3.11.2 Purchase Description

1. SCOPE. This purchase description establishes the requirements for the manufacture and acceptance of the geotechnical diver tools. These tools consist of a miniature standard penetration test (MSPT) device, vane shear, impact corer, vacuum corer, jet probe, and rock classifier.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-1188 Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this purchase description to the extent specified herein.

DRAWINGS (Impact Corer)

NCEL Drawing No.	Title
82-7-1F	Impact Corer
82-7-2F	Impact Corer Details
83-28-1F	Underwater Core Tube Cage
83-27-1F	Kit Box for Impact Corer
83-29-1F	Mailing Box for Tubes Containing Core Samples

(Copies of drawings required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this purchase description and the references cited herein, the text of this purchase description shall take precedence.

3. REQUIREMENTS

3.1 Drawings. The drawings referenced in 2.1.2 are level 2 endproduct drawings. No deviation from the prescribed dimensions or tolerances is permissible without prior approval of the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation. Any data (such as shop drawings, layouts, flow sheets, and processing procedures) that are prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 Dimensions. All tool dimensions shall conform to the requirements specified in the end product drawings referenced in 2.1.2.

3.3 Materials. Materials shall be as specified herein and in other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this purchase description. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Materials shall conform to the requirements specified in the end product drawings listed in 2.1.2.

3.4 Workmanship. All parts, components, and assemblies of the geotechnical tools, including machined surfaces, seals, and welded parts, shall be clean and free from any defects in workmanship. External surfaces shall be free from burrs, slag, sharp edges, and corners except where sharp edges or corners are required.

3.5 Interchangeability. All parts referenced in the drawings in 2.1.2 that are described by the same part number shall be physically and functionally interchangeable.

3.6 Assembly. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.7 Threaded connections and fasteners. No threaded connections or fasteners shall show evidence of cross threading or mutilation.

3.8 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.9 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.10 Weights. Where indicated in drawings, weights of parts and sub-assemblies must be maintained within tolerances stated.

3.11 Seals. Where indicated in drawings, seals shall be installed with the necessary care required to maintain the watertight integrity of the tool.

3.12 Finish. All finishes shall conform to specifications shown in the drawings listed in 2.1.2 and shall be free from nicks, burrs, and surface defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified herein. Except as otherwise specified in the

contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The contractor is responsible for ensuring that components and materials used are manufactured, examined, and tested in accordance with the referenced sections of this purchase description. Each part, subassembly, and assembly shall be inspected according to the inspection requirements specified in Table I.

4.3 Inspection procedure.

4.3.1 Dimensional verification. All components shall be checked for conformance with the dimensions and tolerances specified in the drawings referenced in 2.1.2. Measurement shall be conducted using instruments capable of measurements of ± 0.001 inch.

4.3.2 Visual inspection. Visual inspection shall be performed for compliance with material and workmanship requirements specified in the drawings referenced in 2.1.2.

4.3.3 Mechanical assembly. Component assembly shall be conducted to verify form, fit, and function of individual manufactured components.

4.3.4 Weighing. Components that have weights specified in the drawings referenced in 2.1.2 shall be checked using a standard certified scale capable of ± 0.1 percent accuracy.

4.4 Inspection failure. Failure of production geotechnical tools to meet any requirement specified herein during and as a result of the specified inspection shall be cause for rejection of the production tools and shall be cause for refusal by the Government to continue acceptance of production tools until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

5. PREPARATION FOR SHIPMENT

5.1 Preservation and packaging. All parts and subassemblies shall be preserved and packaged in accordance with MIL-STD-1188.

3.11.3 Manufacturers/Suppliers.

Space is left for you to write in local suppliers.

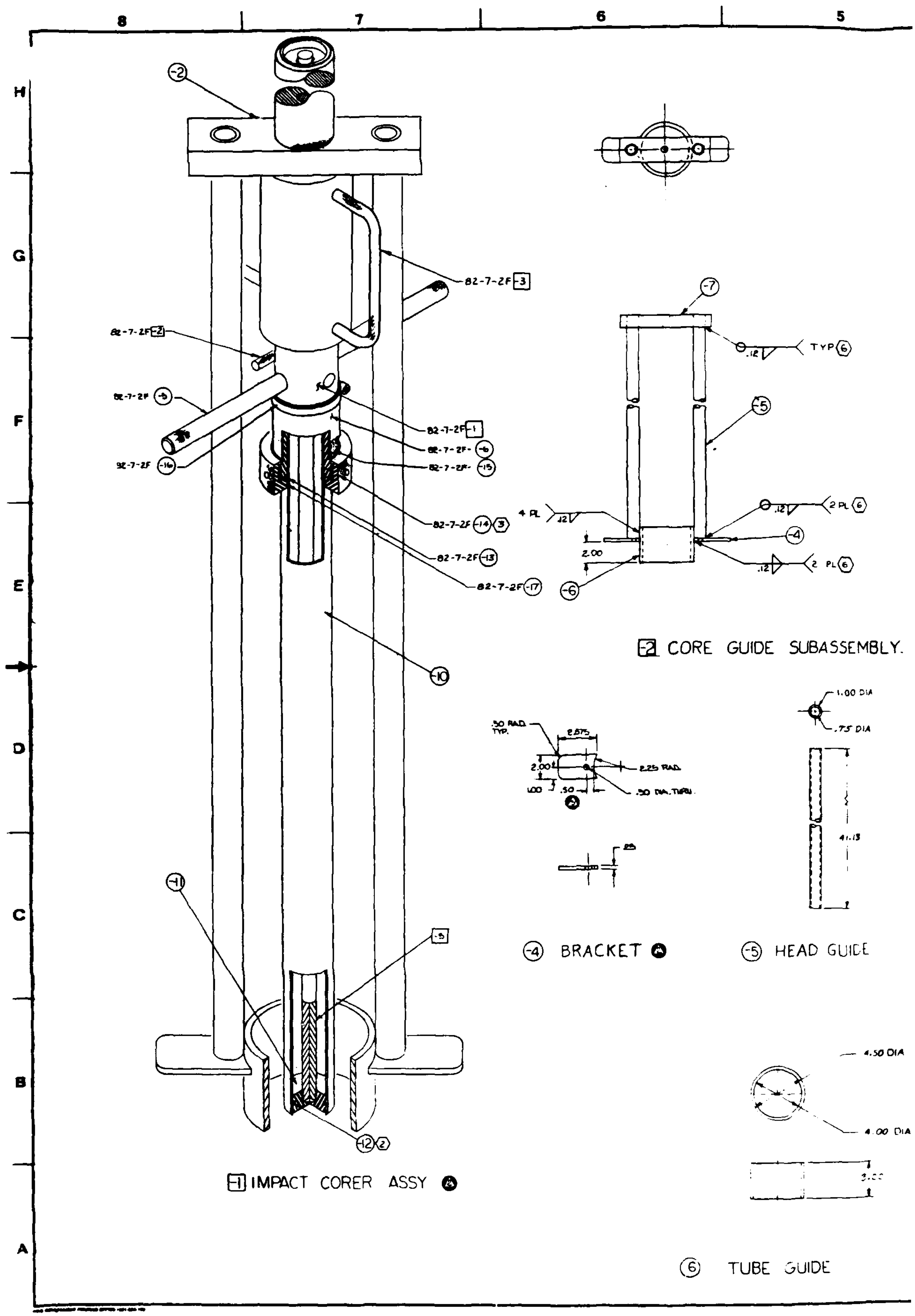
3.11.4 Drawings

The following drawings are included in this section:

Figure No.	NCEL Drawing No.	Title
3.47	82-7-1F	Impact Corer
3.48	82-7-2F	Impact Corer Details
3.49	83-28-1F	Underwater Core Tube Cage
3.50	83-27-1F	Kit Box For Impact Corer
3.51	83-29-1F	Mailing Box For Tubes Containing Core Samples

Table I. Inspection and Test Requirements

Inspection	Number of Sample Units	Requirement Paragraph	Method Paragraph	Number of Failures Allowed
Dimensions not as specified	All units	3.2	4.3.1	None
Materials not as specified	All units	3.3	4.3.2	None
Workmanship not as specified	All units	3.4	4.3.2	None
Interchangeability	All units	3.5	4.3.1	None
Assembly	All units	3.6	4.3.3	None
Threaded connections and fasteners	All units	3.7	4.3.2	None
Welding	All units	3.8	4.3.2	None
Bolted connections	All units	3.9	4.3.2	None
Required component weights	All units	3.10	4.3.4	None
Seals	All units	3.11	4.3.2	None
Finish	All units	3.12	4.3.2	None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-2
82-7-2F 3
82-7-2F 2
82-7-2F -5
82-7-2F 1
82-7-2F -6
82-7-2F -15
92-7-2F -16
82-7-2F -14 3
82-7-2F -13
82-7-2F -17
-10
-11
-3
-12 2
-1 IMPACT CORER ASSY
-7
.12
TYP 6
-5
4 PL
.12
2 PL 6
-4
2.00
.12
2 PL 6
-6
-2 CORE GUIDE SUBASSEMBLY.
.50 RAD. TYP.
2.875
2.00
2.25 RAD.
1.00
.50
.50 DIA. THRU.
.25
1.00 DIA
.75 DIA
41.13
-4 BRACKET
-5 HEAD GUIDE
4.50 DIA
4.00 DIA
6 TUBE GUIDE

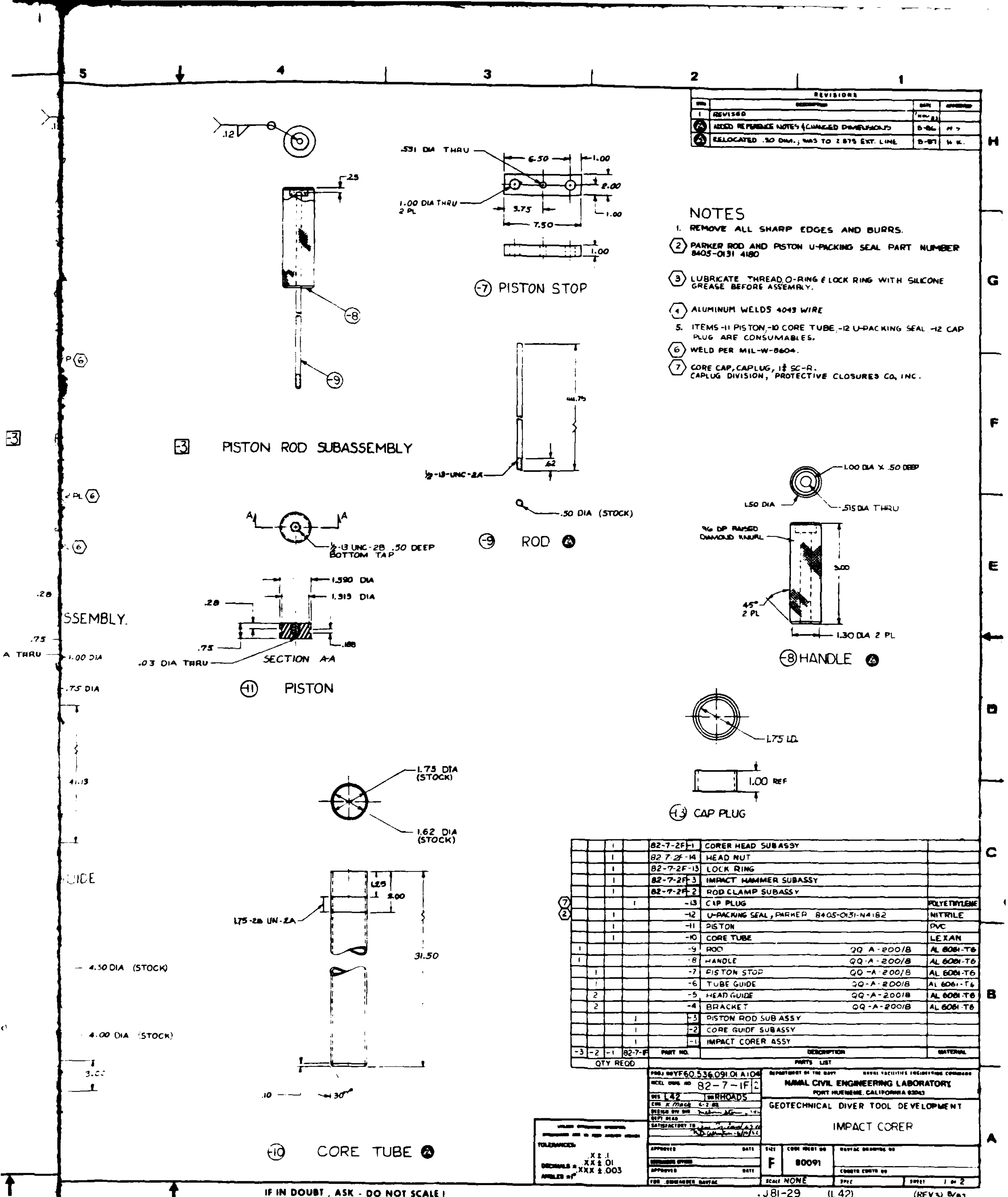
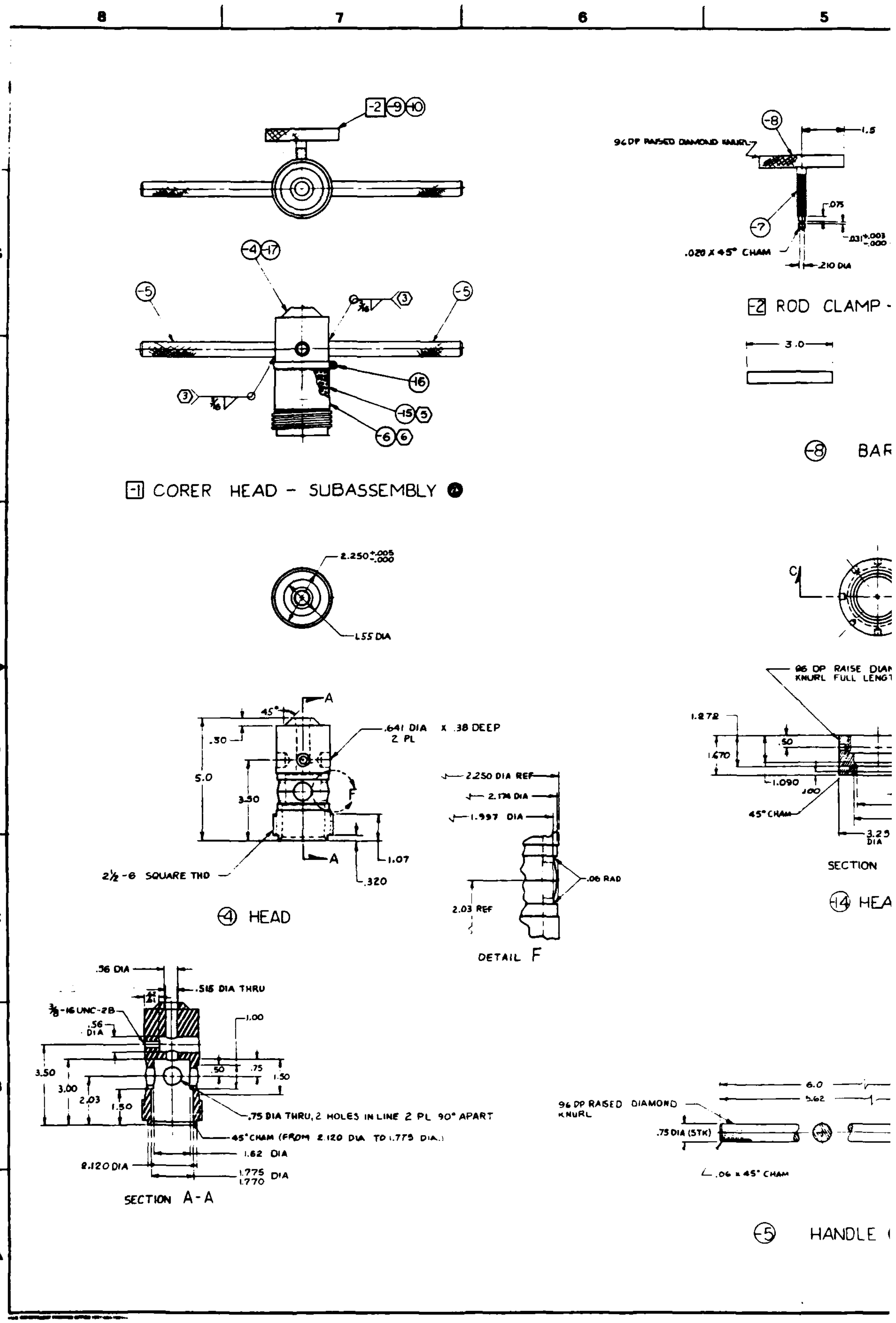


Figure 3.47. Impact corer.



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7
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5
-2 -9 -10
96 DP RAISED DIAMOND KNURL
-8
-1.5
.075
-7
.031 +.003 -.000
.020 X 45° CHAM
.210 DIA
-2 ROD CLAMP
3.0
-8 BAR
-4 -17
-5
3/16
3
-16
-15 5
-6 6
-1 CORER HEAD - SUBASSEMBLY
2.250 +.005 -.000
1.55 DIA
96 DP RAISE DIAMOND KNURL FULL LENGTH
1.272
.50
1.670
1.090
.100
45° CHAM
3.25 DIA
SECTION
-14 HEA
45°
A
.641 DIA X .38 DEEP 2 PL
.30
5.0
3.30
F
1.07
.320
2 1/2 -6 SQUARE THD
-4 HEAD
2.250 DIA REF
2.174 DIA
1.997 DIA
.06 RAD
2.03 REF
DETAIL F
.56 DIA
.515 DIA THRU
3/8-16 UNC-2B
.56 DIA
1.00
3.50
3.00
2.03
1.50
.50
.75
1.50
.75 DIA THRU, 2 HOLES IN LINE 2 PL 90° APART
45° CHAM (FROM 2.120 DIA TO 1.775 DIA.)
1.62 DIA
2.120 DIA
1.775 1.770 DIA
SECTION A-A
6.0
5.62
96 DP RAISED DIAMOND KNURL
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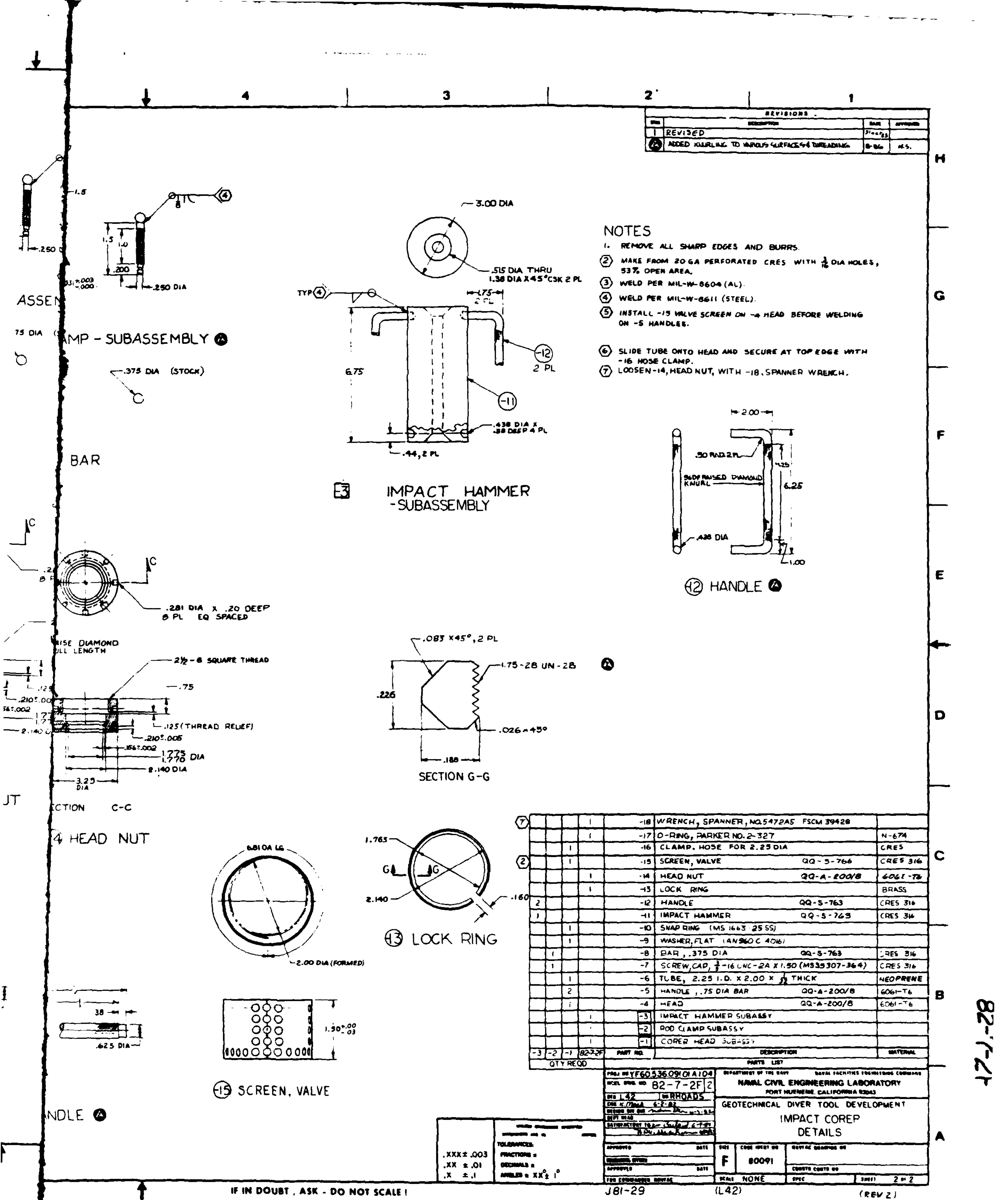
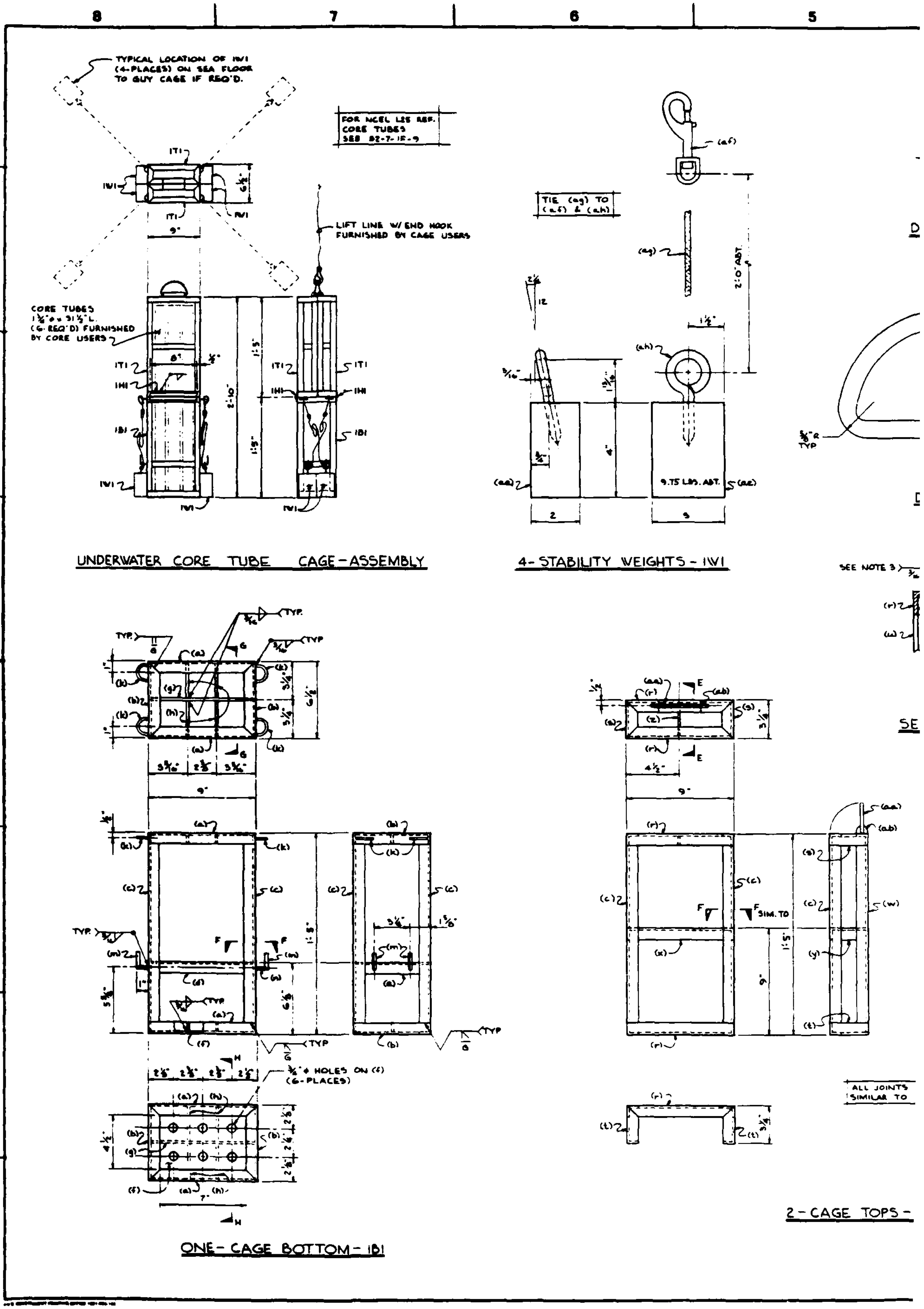
-5 HANDLE
F
E
D
C
B
A

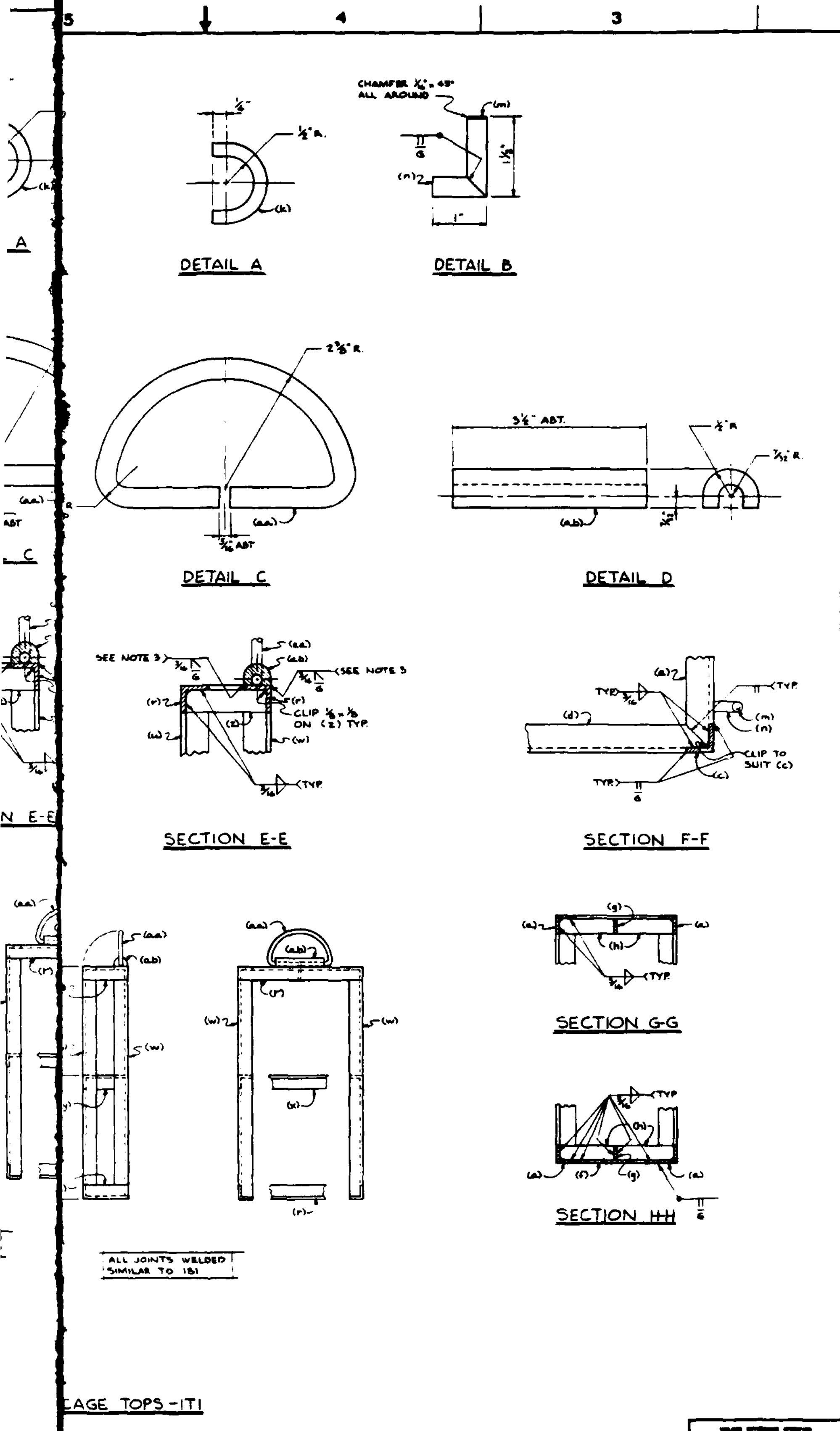


QTY -3	QTY -2	QTY -1	82-7-2F	PART NO.	DESCRIPTION		MATERIAL
			1	-18	WRENCH, SPANNER, NO.5472A5 FSCM 39428		
			1	-17	O-RING, PARKER NO. 2-327		N-674
		1		-16	CLAMP, HOSE FOR 2.25 DIA		CRES
		1		-15	SCREEN, VALVE	QQ-S-766	CRES 316
			1	-14	HEAD NUT	QQ-A-200/8	6061-T6
			1	-13	LOCK RING		BRASS
2				-12	HANDLE	QQ-S-763	CRES 316
1				-11	IMPACT HAMMER	QQ-S-763	CRES 316
		1		-10	SNAP RING (MS 1663 25 SS)		
		1		-9	WASHER, FLAT (AN960 C 416)		
	1			-8	BAR, .375 DIA	QQ-S-763	CRES 316
	1			-7	SCREW, CAP, 3/8-16 UNC-2A X 1.50 (MS35307-364)		CRES 316
		1		-6	TUBE, 2.25 I.D. X 2.00 X 1/32 THICK		NEOPRENE
		2		-5	HANDLE, .75 DIA BAR	QQ-A-200/8	6061-T6
		1		-4	HEAD	QQ-A-200/8	6061-T6
			1	-3	IMPACT HAMMER SUBASSY		
			1	-2	ROD CLAMP SUBASSY		
			1	-1	CORER HEAD SUBASSY		

Figure 3.48. Impact corer details.



TYPICAL LOCATION OF 1W1 (4-PLACES) ON SEA FLOOR TO GUY CAGE IF REQ'D.
FOR NCEL LIS REF. CORE TUBES SEE 82-7-1F-9
LIFT LINE W/ END HOOK FURNISHED BY CAGE USERS
CORE TUBES 1⅞" ø x 31½" L. (6-REQ'D) FURNISHED BY CORE USERS
TIE (ag) TO (af) & (ah)
9.75 LBS. ABT.
UNDERWATER CORE TUBE CAGE-ASSEMBLY
4-STABILITY WEIGHTS - 1W1
⅜" ø HOLES ON (f) (6-PLACES)
ONE-CAGE BOTTOM - 1B1
2-CAGE TOPS -
ALL JOINTS SIMILAR TO
SEE NOTE 3



REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED

NOTES:

1. ALL ALUMINUM SHALL BE 6061-T6.
2. ALL ROUGH EDGES & CORNERS ON ALUMINUM SHALL BE GROUND SMOOTH.
3. INSTALL BAR (aa) BEFORE WELDING (ab) TO (r)

MARK	NO. REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS	
	2	1½" × .045" THK.	0	8	BLANK, ALUM. 6061-T6, MEETS MS-20001	
2 - CONTINUOUS HINGES - IHI (NOT DETAILED)						
ah	4	0.362" ϕ	0	3⅞	BRASS SCREW EYES, 1⅛" I.D. EYE	
ag	4	⅛" ϕ	5	0	100% NYLON CORD MIL-C-5040E	
af	4	⅜" SNAP OPNG	0	4	SWIVEL EYE BOLT SNAPS, REGULAR TYPE, ALL BRASS MEETS MIL-H-15021	
ae	4	BAR 3" × 2"	0	4	LEAD	
4 - STABILITY WEIGHTS - IWI						
ab	2	BAR 1" × 3/16"	0	3½	ALUMINUM	DETAIL D
aa	2	BAR ⅜" ϕ	0	11		DETAIL C
z	2	BAR 13/16" × 3/16"	0	2⅞		
y	4	L 1 × 1 × 3/16	0	2⅞		
x	2		0	8⅝		
w	4		1	3 13/16		
c	4		1	3		
t	4		0	3¼		
s	4		0	3¼		
r	6	L 1 × 1 × 3/16	0	9	ALUMINUM	
2 - CAGE TOPS - ITI						
n	4	BAR ⅜" ϕ	0	1	ALUMINUM	DETAIL B
m	4	BAR ⅜" ϕ	0	1½		DETAIL B
k	4	BAR ¼" ϕ	0	2 7/16		DETAIL A
h	8	BAR 13/16 × 3/16	0	2 31/32		
g	2	BAR 13/16 × 3/16	0	8⅝		
f	ONE	BAR 4½ × 3/16	0	7		
e	2	L 1 × 1 × 3/16	0	6⅛		
d	2		0	8⅝		
c	4		1	3		
b	4		0	6½		
a	4	L 1 × 1 × 3/16	0	9	ALUMINUM	
ONE - CAGE BOTTOM - IBI						

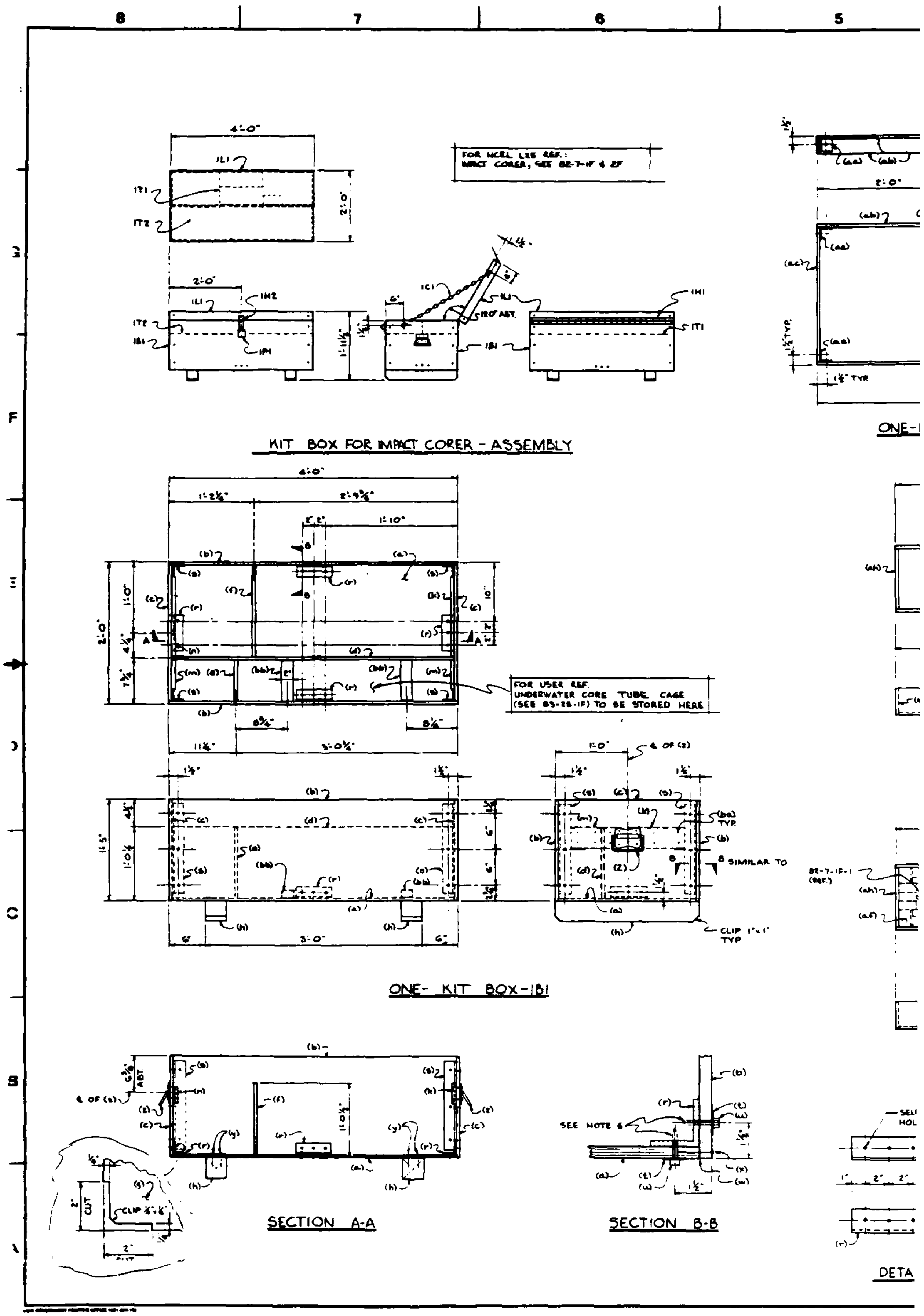
BILL OF MATERIAL

PROJ NO Y1606-01-001-A601	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NCEL DWG NO 83-28-1F	NAVAL CIVIL ENGINEERING LABORATORY, PORT HUENEME, CALIFORNIA 93043
DES H.K / DR H. KUSANO	GEOTECHNICAL TOOL SYSTEM
CHK K. Meck 9-83	UNDERWATER CORE TUBE CAGE
DESIGN DIV DIR 9/83	
DEPT HEAD	
SATISFACTORY TO	
APPROVED / DATE	SIZE F — CODE IDENT NO 80091 — NAVFAC DRAWING NO
BRANCH OR OFFICE	
APPROVED / DATE	CONSTR CONTR NO
FOR COMMANDER NAVFAC	SCALE — SPEC — SHEET 1 OF 1

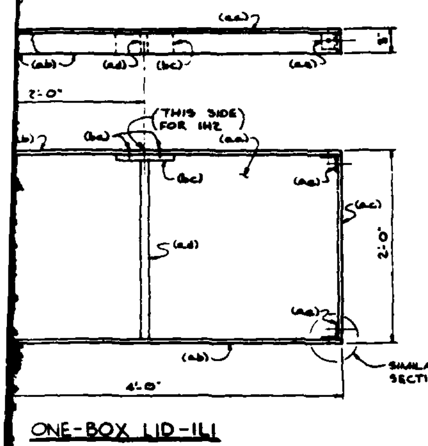
IF IN DOUBT, ASK - DO NOT SCALE!

(L42)

Figure 3.49. Underwater core sample cage.

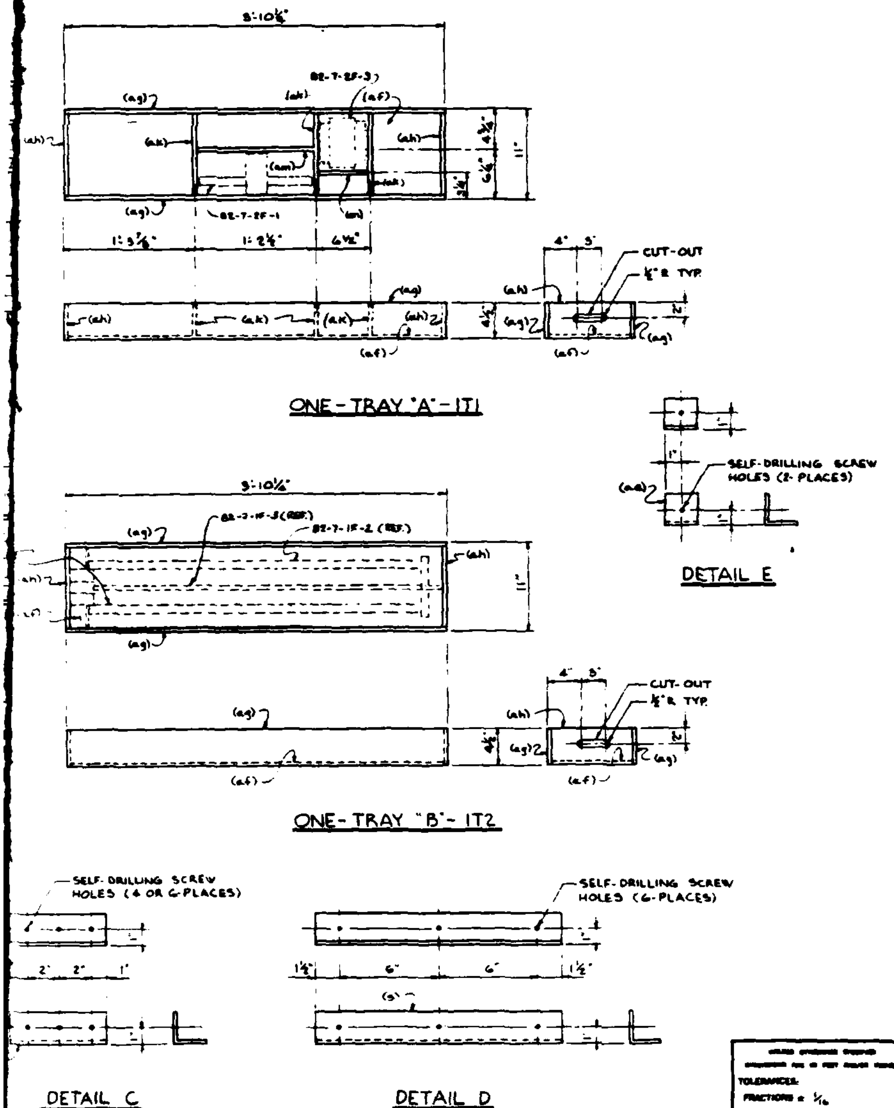


FOR NCEL LES REF.:
IMPACT CORER, SEE 82-7-1F & 2F
KIT BOX FOR IMPACT CORER - ASSEMBLY
FOR USER REF.
UNDERWATER CORE TUBE CAGE
(SEE 83-28-1F) TO BE STORED HERE
ONE- KIT BOX-1B1
SECTION A-A
SECTION B-B
SEE NOTE 6
SIMILAR TO
CLIP 1"x1" TYP



NOTES:

1. ALL PLYWOOD SHALL BE ½-INCH, STRUCTURAL I, C-C EXTERIOR.
2. ALL LUMBER SHALL BE STANDARD-DRESSED CONSTRUCTION GRADE, DOUGLAS FIR.
3. ALL PROTRUDING WOOD SCREWS SHALL BE GROUND, FLUSH
4. ALL WOOD JOINTS SHALL BE GLUED & NAILED. SPACE NAILS @ 2" ON CENTERS FOR 2d & 4d NAILS; 2½" FOR 8d.
5. APPLY PLASTIC WOOD COMPOUND TO ALL PLYWOOD EDGES. PRIME & COAT ALL WOOD SURFACES & EDGES WITH EXTERIOR PAINT; FINISH COLOR TO BE GRAY.
6. ALL PROTRUDING SELF DRILLING SCREWS SHALL BE CUT & GROUND FLUSH TO ALUMINUM ANGLES; COUNTER PUNCH THREADS TO LOCK.
7. ALL ROUGH EDGES & CORNERS ON WOOD & ALUMINUM SHALL BE SANDED & GROUND SMOOTH, RESPECTIVELY.
8. AVAILABLE: McMASTER-CARR SUPPLY CO. LOS ANGELES, CA 90054



MARK	NO. REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS
	4	NO. 6	0	0½	ROUND HEAD SLOTTED SCREWS STAINLESS STEEL 18-8
	2	NO. 35	2	10½	STAINLESS STEEL SASH CHAIN
2-BOX LID CHAINS-1C1 (NOT DETAILED)					
	ONE	1⅞" W x 1⅝" H.			NO. 1957A54, NOTE 8
ONE-PADLOCK-1P1 (NOT DETAILED)					
	A/R	NO. 7 x ⅝" L. FOR 1H1 NO. 7 x 1½" L. FOR 1L1			WOOD SCREWS FLAT HEAD SLOTTED BRASS
	ONE	1⅜" x .150 THK	0	4	CAST BRASS WITH STAPLE PLATE AND SCREWS NO. 1849A9, NOTE 8
ONE-SAFETY HASP-1H2 (NOT DETAILED)					
	A/R	NO. 6 x ½" L.			FLAT HEAD SLOTTED, STAINLESS STL 18-8
	ONE	2" x .060" THK.	4	0	STAINLESS STEEL TYPE 3022B
ONE-CONTINUOUS HINGE-1H1 (NOT DETAILED)					
x	A/R	4d NAILS			SEE 1B1 REMARKS
w	A/R	GLUE			SEE 1B1 REMARKS
an	1	½ x 4	0	6	PLYWOOD
am	ONE	½ x 4	1	2	
ak	3	½ x 4	0	10	
ah	4	½ x 4½	0	10	
ag	4	½ x 4½	3	10½	
af	2	½" x 10	3	9½	PLYWOOD
ONE-TRAY "A"-1T1 & ONE-TRAY "B"-1T2					
bc	ONE	1 x 2½	0	7	LUMBER
ba	A/R	2d NAILS			SEE 1B1 REMARKS
x	A/R	4d NAILS			
w	A/R	GLUE			
u	8	SCREWS			
t	8	WASHERS			SEE 1B1 REMARKS
ae	4	L2 x 2 x ⅛	0	2	ALUMINUM 6061 DETAIL E
ad	ONE	1 x 2½	1	10½	LUMBER
ac	2	½ x 2½	1	11	PLYWOOD
ab	2	½" x 2½	4	0	"
aa	ONE	½" x 24"	4	0	PLYWOOD
ONE-BOX LID-1L1					
bb	2	1½ x 2"	0	7"	LUMBER (CUT FROM 2x3)
ba	A/R	2d NAILS			GALVANIZED STEEL
z	2	3¾" x 4¼"			CAST BRASS CHEST HANDLE, NO. 1646A6 NOTE 8, W/ NO. 10 x 1¼" L., S.S. 18-8 SCREWS
y	A/R	8d NAILS			GALVANIZED STEEL
x	A/R	4d NAILS			GALVANIZED STEEL
w	A/R	GLUE			WATERPROOF RESORCINAL
u	46	.216" ϕ	0	1⅛	HEX WASHER HEAD ZINC PLATED STEEL, SELF DRILLING SCREWS, NO. 90032A306, NOTE 8
t	46	¼" I.D. x ⅞" O.D. x .05" THK			FLAT WASHERS, STAINLESS STEEL 18-8
s	4	L2 x 2 x ⅛	1	3	ALUMINUM 6061 DETAIL D
r	4	L2 x 2 x ⅛	0	6	ALUMINUM 6061 DETAIL C
					LUMBER
n	ONE	1 x 4	4	2	
m	2	1 x 4	0	5	
k	ONE	1 x 4	1	1½	
h	2	4 x 4	2	0	LUMBER
					PLYWOOD
f	ONE	½" x 12"	1	3½	
e	ONE	½" x 2"	0	7	
d	ONE	½" x 12"	3	11	
c	2	½" x 17"		11	
b	2	½" 17"	4	0	
a	ONE	½" x 23	3	11	PLYWOOD
ONE-PARTS BOX-1B1					

BILL OF MATERIAL

PROJ NO Y1606-01-001-A601	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NCEL DWG NO 83-27-1F	NAVAL CIVIL ENGINEERING LABORATORY, PORT HUENEME, CALIFORNIA 93043
DES H.K. — DR H KUSANO	GEOTECHNICAL TOOL SYSTEM
CHK K Mack 9-83	KIT BOX FOR IMPACT CORER
SIZE F	CODE IDENT NO 80091
SCALE NONE	SHEET 1 OF 1

TOLERANCES: FRACTIONS ± 1/16, DECIMALS ±, ANGLES ±

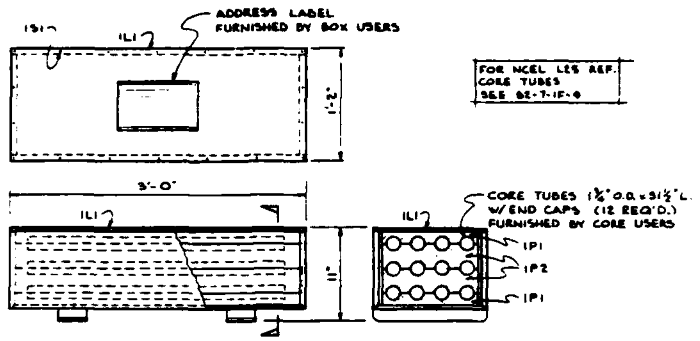
IF IN DOUBT, ASK - DO NOT SCALE!

(L42)

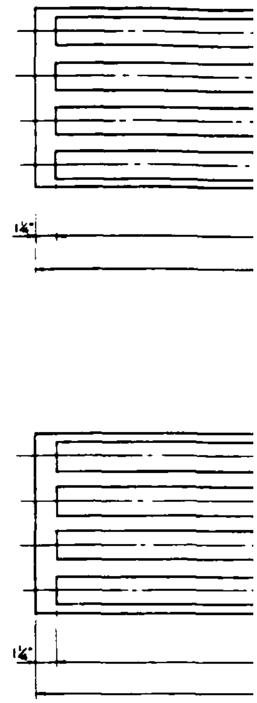
83-27-1F

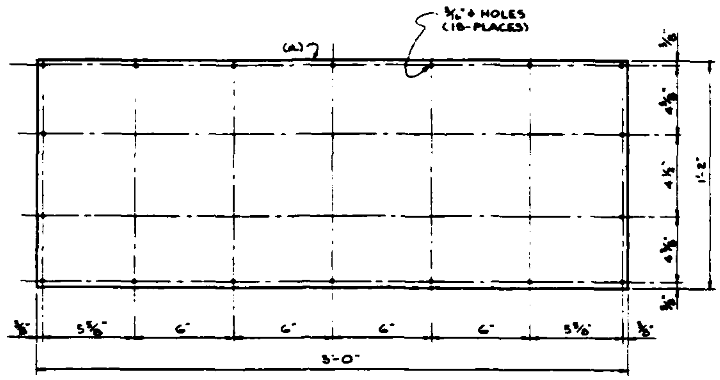
Figure 3.50. Kit box for impact corer.

8 7 6 5

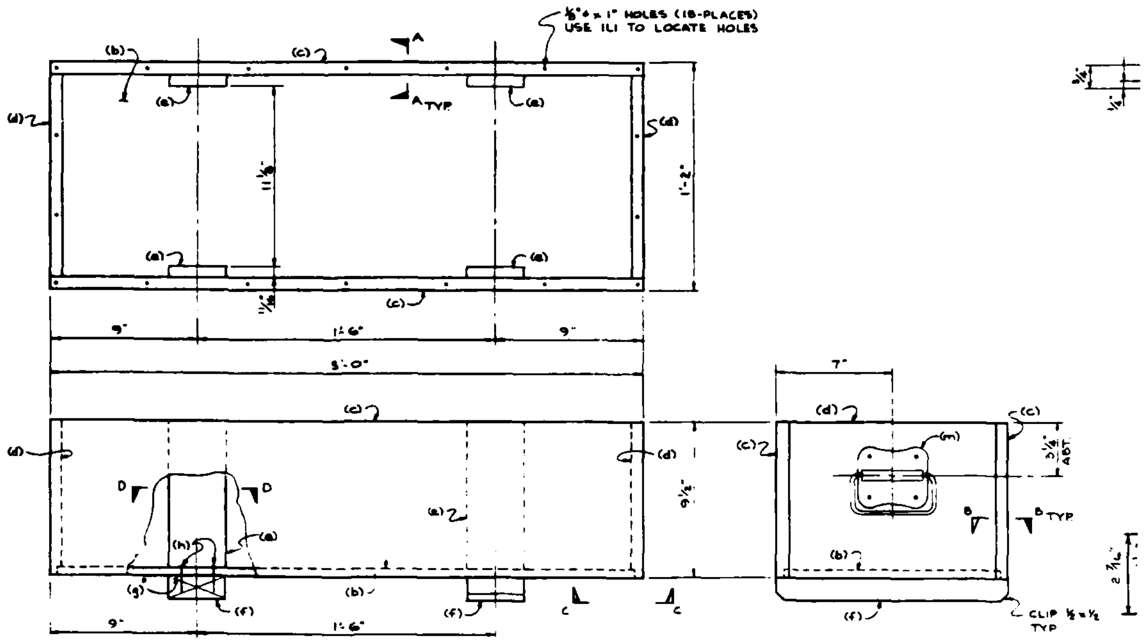


MAILING BOX FOR CORE TUBES CONTAINING SAMPLES-ASSEMBLY

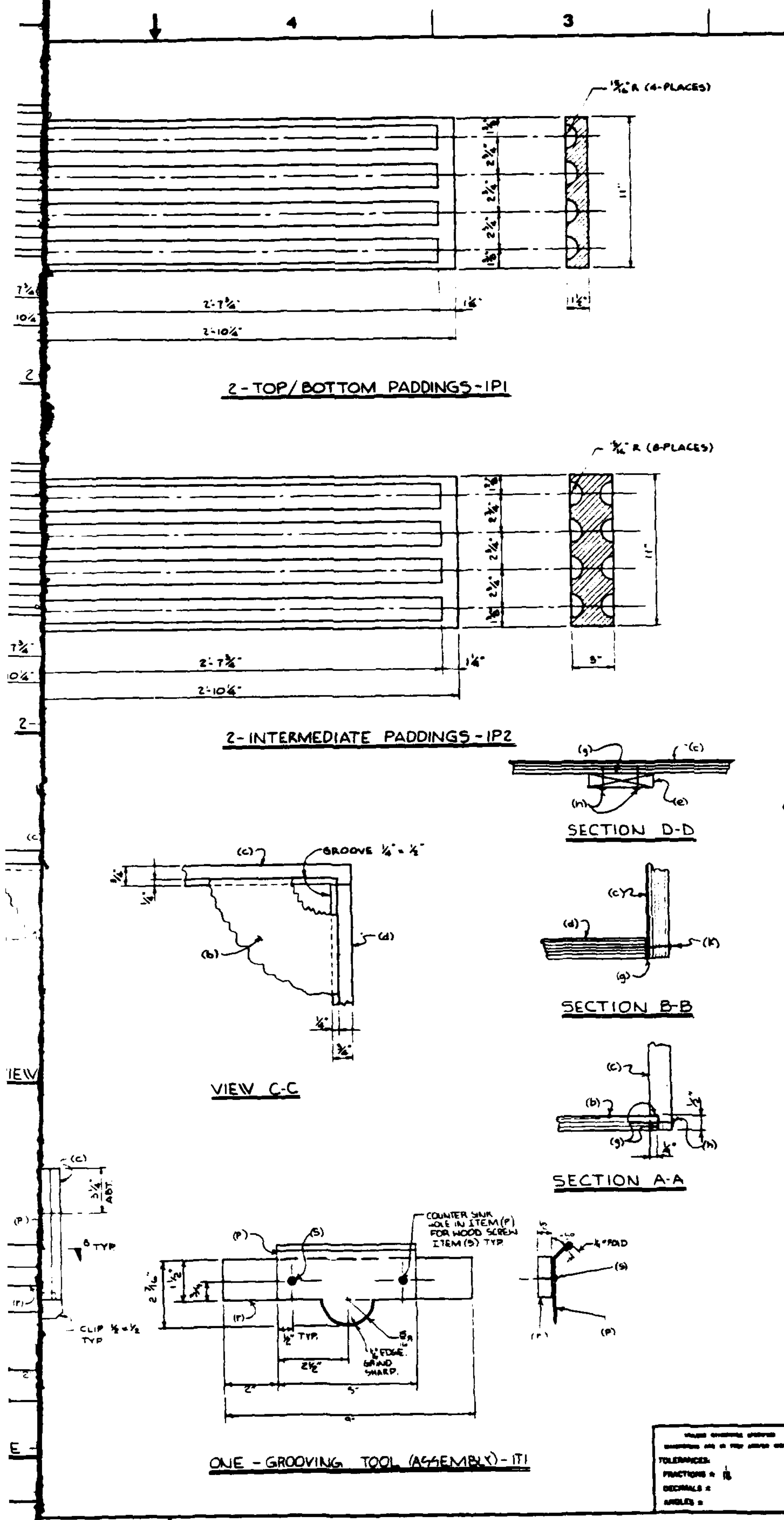




ONE-BOX LID-1L1



ONE- MAILING BOX - 1B1



NOTES:

1. ALL PLYWOOD SHALL BE STRUCTURAL I C-C EXTERIOR.
2. ALL LUMBER SHALL BE STANDARD-DRESSED CONSTRUCTION GRADE, DOUGLAS FIR.
3. ALL ROUGH EDGES & CORNERS ON WOOD SHALL BE SANDED SMOOTH.
4. ALL PROTRUDING WOOD SCREWS SHALL BE GROUND FLUSH
5. ALL WOOD JOINTS SHALL BE GLUED & NAILED. SPACE 4d & 6d NAILS @ 2" ON CENTERS.
6. APPLY PLASTIC WOOD COMPOUND TO ALL PLYWOOD EDGES. PRIME & COAT ALL WOOD SURFACES & EDGES WITH EXTERIOR PAINT; FINISH COLOR TO BE GRAY.
7. SPRAY TEFLON TO 1P1 & 1P2. THE CORE TUBES SHALL NOT STICK TO 1P1 & 1P2.
8. PLACE CORE TUBE W/END CAPS IN EACH SLOT OF 1P1 & 1P2 FOR FITNESS TEST.
9. GROOVING TOOL USED FOR CUTTING SEMI-CIRCULAR CROSS SECTIONS IN POLYURETHANE FOAM PADDINGS (ITEMS 1P1 & 1P2)

MARK	NO REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS
s	2	NO. 7	0	½	WOOD SCREW, FLAT HEAD SLOTTED, STEEL
r	1	½" × 1½	0	9	LUMBER (ANY GRADE)
p	1	1/32 THK × 3 7/16	0	5"	STEEL
ONE-GROOVING TOOL-1T1					
	18	NO 8	0	1½	FLAT HEAD SLOTTED, S.S. 18-8
18-BOX SCREWS-1S1					
	2	3 × 11	2	10⅞	POLYURETHANE FOAM FIRM DENSITY
2-INTERMEDIATE PADDINGS-1P2					
	2	1½ × 11	2	10⅞	POLYURETHANE FOAM, FIRM DENSITY
2-TOP/BOTTOM PADDINGS-1P1					
n	A/R	3d NAILS			STAINLESS STEEL 18-8
m	2	3¼ × 4¼			CAST BRASS CHEST HANDLE, BURNISHED FINISH, W/NO. 10 × ¾" L. SCREWS, F.H.SLOT, S.S. 18-8
k	A/R	6d NAILS			STAINLESS STEEL 18-8
h	A/R	4d NAILS			STAINLESS STEEL 18-8
g	A/R	GLUE			WATERPROOF RESORCINAL
f	2	2 × 4	1	2	LUMBER
e	4	1 × 4	0	9	LUMBER
d	2	¾ × 9½	1	0⅞	PLYWOOD
c	2	¾ × 9½	3	0	"
b	ONE	½ × 13	2	11	PLYWOOD
ONE-MAILING BOX-1B1					
a	ONE	½" × 14"	3	0	PLYWOOD
ONE-BOX LID-1L1					

BILL OF MATERIAL

PROJ NO Y1606-01-001-A601
NCEL DWG NO 83-29-1F

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

GEOTECHNICAL TOOL SYSTEM
MAILING BOX FOR CORE TUBES CONTAINING SAMPLES

SIZE F — CODE IDENT NO 80091

83-29-1F

Figure 3.51. Mailing box for core samples.

CHAPTER 4

VANE SHEAR TOOL

4.1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

4.1.1 General Information

The vane shear tool is a hand-operated diver tool that takes in-situ vane shear data in cohesive soils. Data can be taken at 6-inch intervals to a soil depth of 30 inches. A photograph of the vane shear tool is shown in Figure 4.1. The major components of the tool are identified in the photograph. The tool is 34 inches long and weighs 12 pounds in air and 10 pounds in seawater. It takes about 10 minutes to take a complete set of data with the vane shear tool.

The vane shear tool is packaged as a kit together with the miniature standard penetration test (MSPT) kit in one box. Spare and repair parts for the vane shear tool are in the kit. Some of the support equipment in the box is shared between the vane shear kit and the

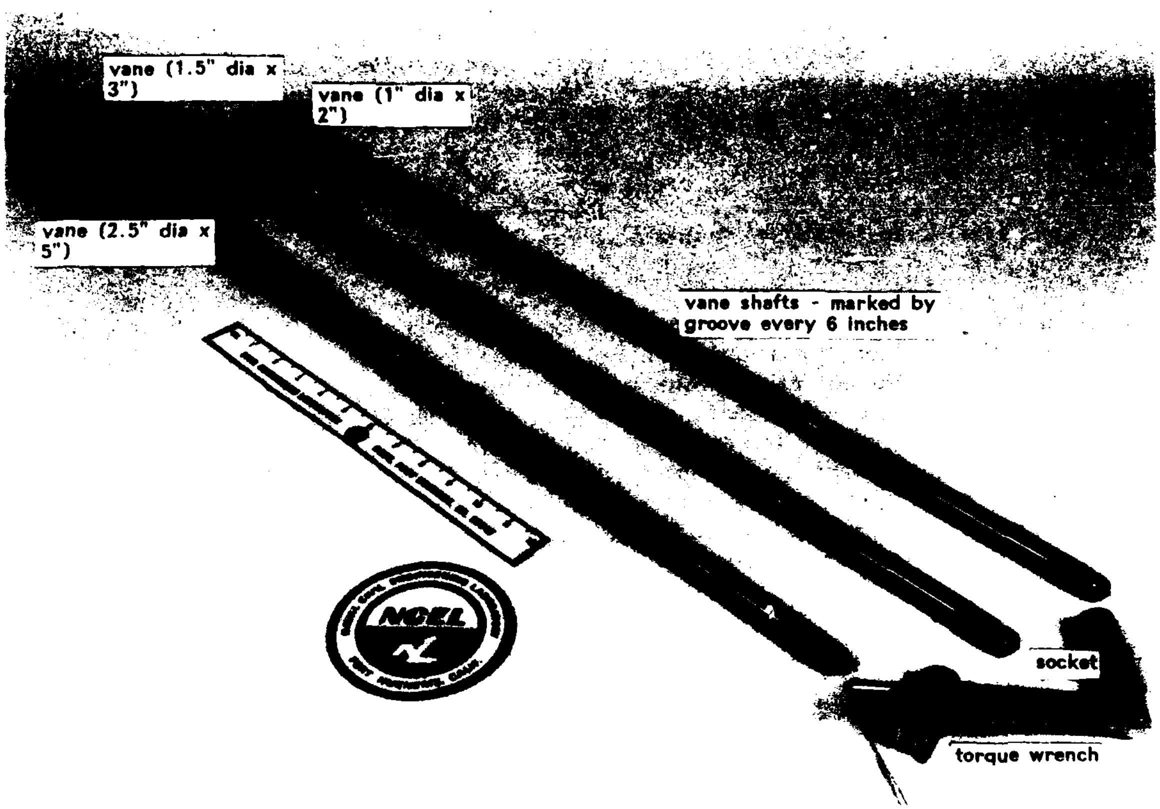


Figure 4.1. Vane shear tool.

MSPT kit. The box is 4 feet long, 2 feet wide, and 1.4 feet tall. It weighs 146 pounds when fully equipped.

The geotechnical data taken with the vane shear tool are in-situ (in the natural site) vane shear data and are of two types: original and remolded. Original data are the first shear strengths measured in the soil. Remolded data are shear strengths measured in the soil after it has been disturbed. The original shear strength and the remolded strength can be used to determine the sensitivity of the soil. Vane shear strength is measured only in cohesive soils. Vane shear data taken in cohesionless soils have no meaning. The vane shear tool measures the maximum torque required to turn the vane in the soil and cause soil failure. This torque (inch-pounds) is converted to vane shear strength (pounds per square inch) through an equation (see Section 4.10).

4.1.2 Safety Precautions

The vane shear tool is a hand-operated tool that presents no safety hazards.

1. Use cleaning solvents and lubricants in a well-ventilated area only. Avoid prolonged breathing of the fumes or contact with the skin.

2. For reliable data, keep torque wrenches calibrated.

3. Use only a soft lead hammer to drive the vane shafts into the seafloor; this allows the hammer to deform, not the top of the vane shaft. If the top of the vane shaft is deformed, the socket attached to the torque wrench will not fit properly, which will result in bad data, and the MSPT drive head will not attach to the top of the vane shaft, which can be used to remove the vane shaft from the seafloor.

4.2 FUNCTIONAL DESCRIPTION

4.2.1 Introduction

This section provides a functional description of the vane shear tool and the theory of operation.

4.2.2 Tool Function

The tool's function is to take in-situ vane shear data in cohesive soils. The tool takes both original and remolded data to a depth of 30 inches in the seafloor.

4.2.3 Functional Sequence

The vane shear tool is taken to the seafloor by the divers. On the seafloor, the divers first insert the vane into the cohesive soil
vertically and push it in until the first groove is at the seafloor. The torque wrench is attached to the top of the vane shaft. The torque wrench is turned until the soil fails (gives way) and the maximum torque reached is shown on the torque wrench by the memory marker. This maximum torque is recorded by the divers. After a good torque reading is achieved on the original test, the vane is turned in the soil 10 turns to disturb (remold) the soil and the test is run again. This remolded torque value is also recorded by the divers. The vane shaft is then pushed in to the next groove (6 inches) and the whole process is repeated until data have been taken every 6 inches to a depth of 30 inches (five sets of data).

4.2.4 Component Function and Theory of Operation

4.2.4.1 Vanes. The vanes are used to cause the soil to fail in shear. The failure plane is a cylindrical surface around the circumference of the vane as is shown in Figure 4.2. This failure plane is an assumed failure plane. The actual shape of the failure plane or surface during vane shear testing is still under investigation by geotechnical researchers. The amount of shear strength the soil has along the failure surface or the way it varies (shape) is also assumed. The shape assumed in the equation used for this tool is shown in Figure 4.3. Like the shape of the failure surface, the intensity is also still being researched. Vane shear strength will differ from the actual shear strength of the soil. The vane creates a failure surface along which the soil has a certain amount of shear strength. If a different kind of load is put on the soil, it will fail along its weakest plane, whatever

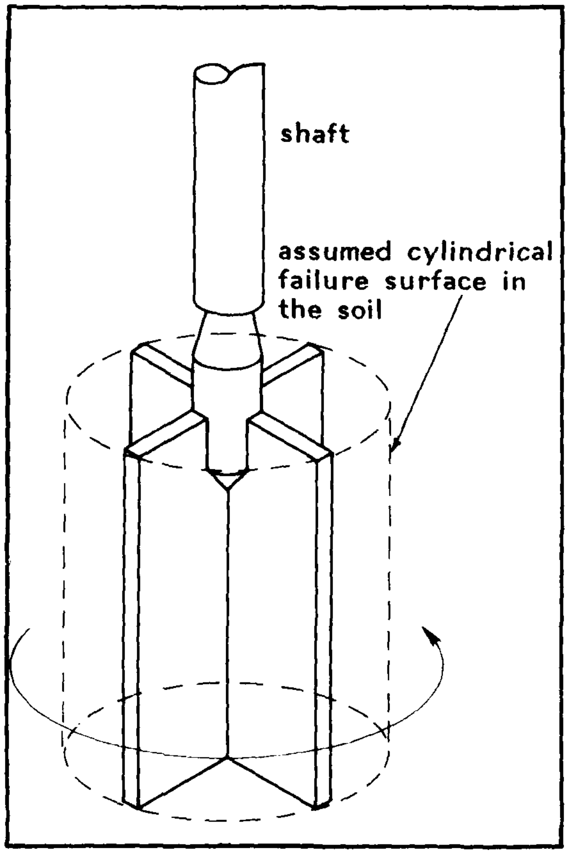


Figure 4.2. Assumed failure surface.

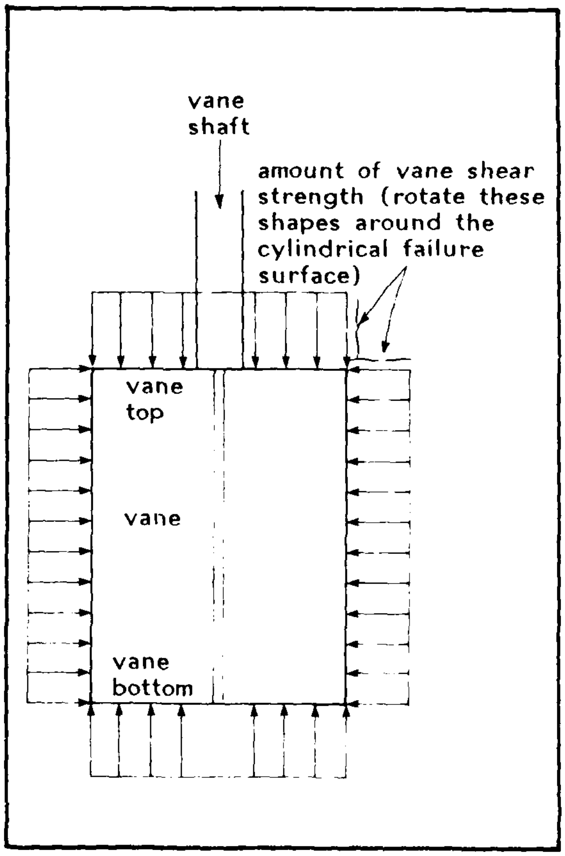


Figure 4.3. Shear strength around vane.

that plane is, and it is sure to be different from the one created by the vane. The equation used to convert the torque to vane shear strength based on the assumptions above is derived in Section 4.10.

The vanes are used to measure the original shear strength and the remolded shear strength of the soil. The original value is from the first test run on undisturbed soil. The remolded value is measured after the soil has been disturbed by rotating the vane through 10 turns. The remolded strength is always equal to or less than the original strength. The original strength divided by the remolded strength is called the sensitivity of the soil. The sensitivity is explained further in Section 4.10.

Three sizes of vanes are provided with the tool. These sizes were chosen to cover the range of shear strengths that could be encountered on the seafloor while keeping the torque required to produce failure below the 50-in.-lb capacity of the torque wrench. This range is shown in Figure 4.4. As can be seen in Figure 4.4, the softer the soil, the larger the vane used. There is an American Society for Testing and Materials (ASTM) standard for the field vane shear test: ASTM D 2573-72 (reapproved 1978). This tool does not adhere strictly to this standard. It is a much simpler tool than the tool used on land. The largest size vane (2-1/2-inch diameter and 5-inch height) and the middle size vane (1-1/2-inch diameter and 3-inch height) are standard sizes. The smallest size vane (1-inch diameter and 2-inch height) is not a standard size. It is recommended that this vane not be used unless the torque wrench reaches its maximum value with the middle vane. If the soil is so stiff that it requires this small vane, it would probably be better to take several cores for laboratory miniature vane shear tests and

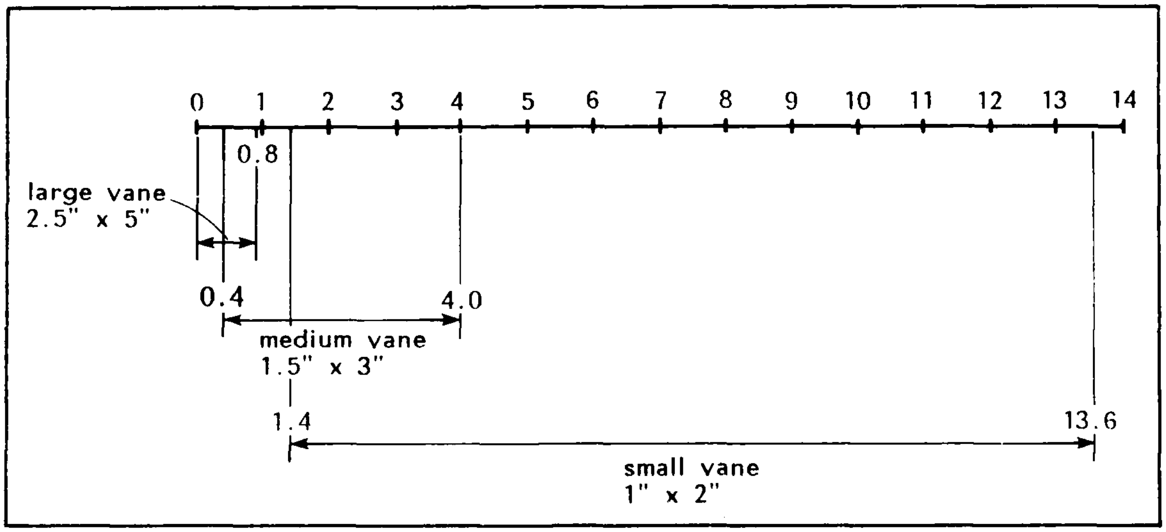


Figure 4.4. Range of vane shear strength for seafloor soils (psi).

triaxial tests. The small vane is so close in size to the shaft, much of the shear strength measured in the soil can be due to the friction on the shaft. The amount of strength due to the shaft can be measured with the vaneless shaft provided in the kit.

The speed of rotation of the vane also affects the amount of shear strength measured. The ASTM standard requires the vane to be rotated at a rate of 0.1 deg/sec. This is very, very slow! A quarter of a turn, 90 degrees, would take 15 minutes. It is probably impossible for the diver to turn the torque wrench this slowly, but the point is to turn the torque wrench as slowly as possible. The soil failure will almost always occur within 90 degrees. Turning the vane faster will result in higher strength measurements.

4.2.4.2 Vane Shaft. The vane shaft provides a way to insert the vane into the soil and transmit torque from the torque wrench to the vanes. However, the friction along the shaft contributes to the measured torque. The torque due to the shaft alone should be measured for each site tested on a shaft with no vane on the end (a vaneless shaft is provided for this purpose). The top of the shaft is shaped to allow the torque wrench to be easily attached. It is also shaped to allow the anvil, hammer, and guide shaft from the MSPT to be attached. With these items attached, the vane shaft can be driven upward and out of the soil if it is difficult to remove at the end of a test.

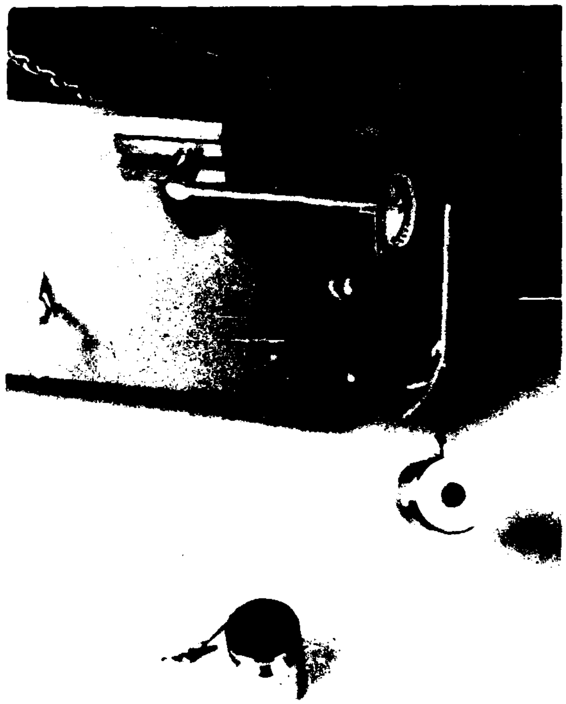
4.2.4.3 Socket. The socket is used as a connection between the vane shaft and the torque wrench. This allows the torque wrench to be easily lifted off the shaft and taken to a shallower water depth where visibility may be better to read the torque.

4.2.4.4 Torque Wrench. The torque wrench is used to measure the torque required to turn the vane in the soil. The torque wrench has a memory marker on it to record to maximum torque when the soil fails. The torque wrench has a maximum capacity of 50 in.-lb. If the torque wrench reaches the maximum of 50 in.-lb, switch to the next smaller vane.

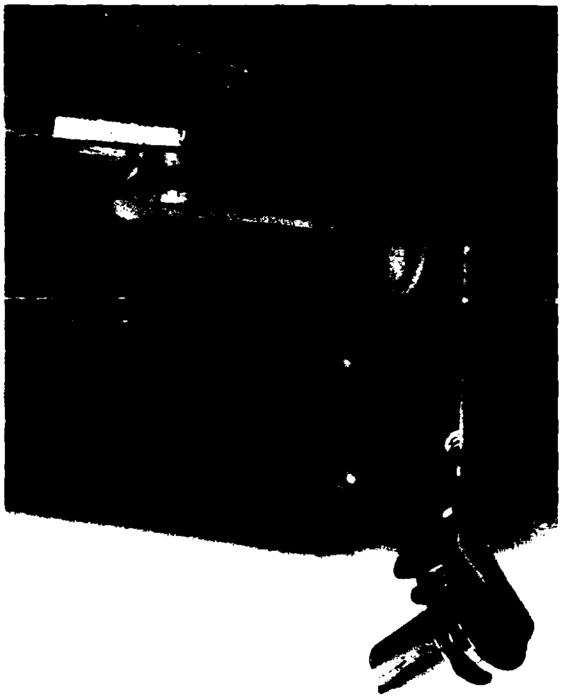
4.3 ASSEMBLY, OPERATION, AND DATA RECORDING

4.3.1 Introduction

This section explains step-by-step the assembly, operation, and data recording for the vane shear tool. Before the vane shear tool



(a)



(b)

Figure 4.5. Torque wrench tester.

is used, the divers should determine if the soil at the site is cohesive. If there is any doubt, the vane shear tests should be run anyway and a sample of the soil taken for later determination of soil type. The impact corer can be used for this. If the corer is not available, a bulk sample in a plastic bag is better than nothing.

4.3.2 Assembly

The steps to assemble the vane shear tool are given below. Be sure to apply the proper lubricants as needed. Refer to the illustrated parts breakdown (Section 4.7) for identification of parts. Due to the simple nature of the vane shear tool, most of the assembly is done by the divers underwater.

ASSEMBLY STEPS:

1. Check the torque wrench for accuracy with the torque tester as follows (Figure 4.5):

(a) Attach vise to side of kit box, grip socket joint end of torque wrench in vise, and hang one 1-kg weight from the string in the handle of the torque wrench. The torque wrench should read 14 in.-lb (Figure 4.5a). Record the value you read, even if it is not 14. The reading can be used to adjust data taken with the torque wrench.

(b) Add the second 1-kg weight to the torque wrench, keeping the first one on (Figure 4.5b). It should now read 28 in.-lb. Record the value you read on the torque wrench, even if it is not 28.

(c) If you do not get 14 and 28 in.-lb, check the other torque wrench in the kit. Use whichever torque wrench comes the closest to 14 and 28. Record the actual readings taken with the torque tester on the data sheet. These numbers can be used to correct the data taken with the inaccurate wrench.

2. Attach the torque wrench to the socket, applying a small amount of lubricant such as LPS-3 (Figure 4.6).

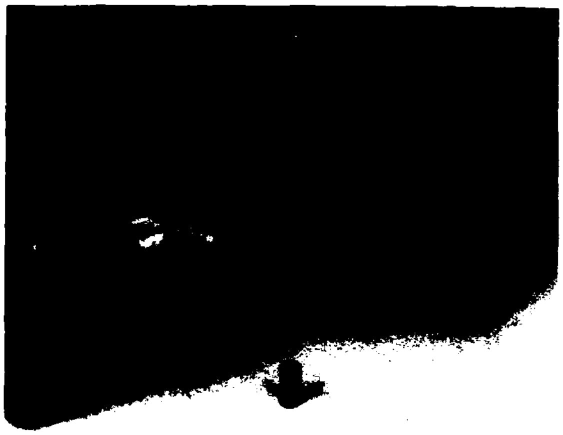


Figure 4.6. Lubricating torque wrench before attaching socket.

3. Check fit of socket on top of all vane shafts.

4. Assemble the following items (Figure 4.7) to be taken down by the divers to run the vane shear tests:

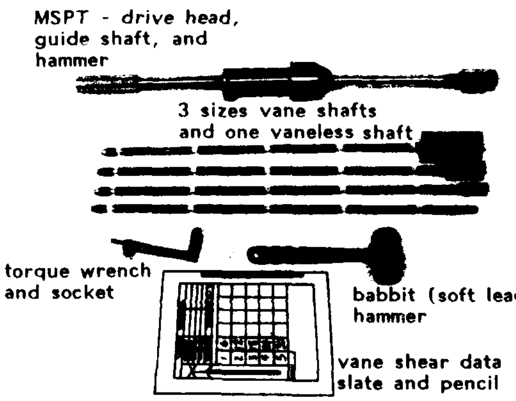


Figure 4.7. Diver's set.

- torque wrench and socket
- set of 3 vane shafts
- slate
- babbit hammer (if soil is stiff)
- MSPT anvil, hammer, and guide shaft (if soil is stiff)

4.3.3 Operation

There are two types of tests to be done with the vane shear tool, the original strength test and the remolded strength test. The operation of the tool below will describe both processes.

OPERATION STEPS:

1. Divers swim down with tool and accessories.

2. Start with largest vane (Figure 4.8). Insert vane in soil until the first groove is at the seafloor level (Figure 4.9).

Figure 4.8. Inserting vane in seafloor.

Figure 4.9. Attaching torque wrench.

Figure 4.10. Torque wrench on vane shaft.

3. Attach torque wrench to top of vane shaft (Figure 4.10).

4. Place memory marker at the center zero of the scale on the torque wrench (Figure 4.11).

5. Rotate torque wrench very, very slowly clockwise until soil fails (gives) (Figure 4.12). The rate of rotation should be 90 degrees (quarter turn) in 15 seconds or slower.

6. Read maximum torque marked by the memory marker. If visibility is poor near the bottom, lift the torque wrench off the shaft, leaving the shaft in the seafloor, and move up to clearer water to read the torque (Figure 4.13). Record torque on slate under column labeled "original."

7. Attach torque wrench on top of vane shaft and rotate vane in soil ten times. This is called "remolding" (disturbing) the soil. Do not change the depth of the vane in the soil.

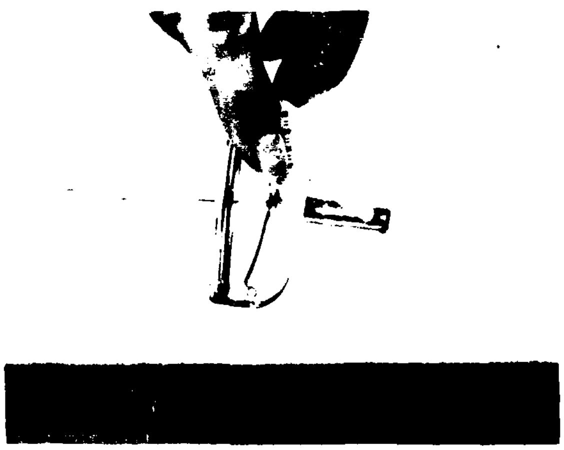


Figure 4.11. Setting memory marker to zero.

Figure 4.12. Turning vane.

Figure 4.13. Recording data.

8. Place memory marker at zero on scale.

9. Turn torque wrench very, very slowly until soil fails. Rate of rotation should be 90 degrees (quarter turn) in 15 seconds or slower.
10. Read maximum torque recorded by memory marker and record on slate (use lead pencil only) under the column labeled "remold."

11. Push vane shaft into seafloor until the next groove is level with the seafloor. If the vane cannot be pushed in, use soft, lead babbit hammer to gently drive shaft in (Figure 4.14). Use only a soft hammer. A hard hammer will deform the top of the shaft until neither the torque wrench nor the MSPT drive head will attach to the top of the shaft.

Figure 4.14. Using soft lead hammer on vane shaft.

12. Repeat steps 3 through 12 until five sets of data have been taken (the vane shaft has penetrated a full 30 inches), both original and remolded data at each groove.

Figure 4.15. Attaching MSPT drive head, hammer, and guide shaft to vane shaft stuck in mud.

Figure 4.16. Hammering vane shaft out.

13. If the vane shaft cannot be removed from the seafloor, screw the MSPT drive head with its hammer and guide shaft onto the threads at the top of the vane shaft (Figure 4.15). Hammer upwards with the MSPT hammer to remove the vane shaft from the seafloor (Figure 4.16).

4.3.4 Data Recording

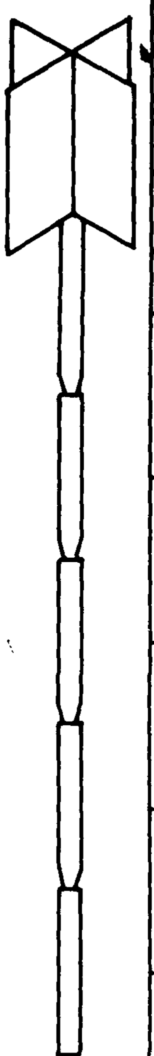
The data taken with the vane shear tool are recorded on the diver's slate and then later transferred to data sheets. The diver's slate is shown in Figure 4.17 and the data sheet is in Figure 4.18. From the example site survey in Chapter 2, for Site A, vane shear data taken at data locations AA-3 and AA-4 would be recorded on the slate as shown in Figure 4.19. At the end of the dive, the information would be transferred from the diver's slate to a data sheet as shown in Figure 4-20. Use only a soft lead pencil on the slate; erase the pencil with an eraser, then clean the slate with cleanser or soap and water. These data are torque measurements in inch-pounds. To convert these torque measurements to vane shear strength in pounds per square inch, see Section 4.10.

4.3.5 Summary Instruction Sheet

The above instructions for the assembly and operation of the impact corer have been condensed to one page with an illustrated parts breakdown on the back side (Figure 4.21). A copy of this page can be laminated and kept in the kit box for quick field reference. These instructions are very brief and are intended to function as a reminder, so the manual should be read first.

USE SOFT LEAD PENCIL ONLY

VANE SHEAR



Site & Data ID					
Vane Size					
Vane Serial #					
Torque Wrench Serial #					
DEPTH		TORQUE (in-lb)			
mark	inches	Original	Remold	Original	Remold
1	6				
2	12				
3	18				
4	24				
5	30				

NOTES:

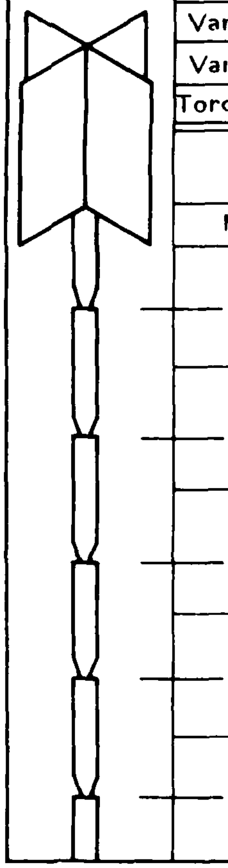
Figure 4.17. Diver's slate for vane shear data.

VANE SHEAR DATA SHEET

Project: ____________________

Date: ____________________ Time: ____________________

Divers: ____________________



VANE SHEAR DATA FROM DIVER'S SLATE					
Site + Data ID No.					
Vane Size					
Vane Serial No.					
Torque Wrench Serial No.					
DEPTH		TORQUE			
Mark	Inches	Original (in.-lb)	Remold (in.-lb)	Original (in.-lb)	Remold (in.-lb)
1	6				
2	12				
3	18				
4	24				
5	30				

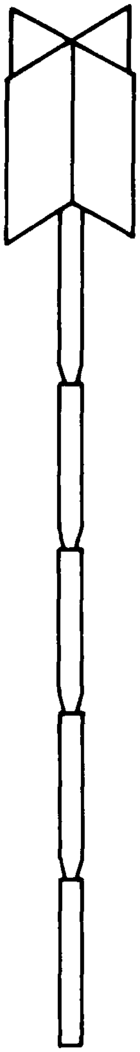
Observations: ____________________

Problems: ____________________

Figure 4.18. Vane shear data sheet.

USE SOFT LEAD PENCIL ONLY

VANE SHEAR



Site & Data ID		AA-3		AA-4	
Vane Size		Large		Large	
Vane Serial #		L-2		L-2	
Torque Wrench Serial #		08345		08345	
DEPTH		TORQUE (in-lb)			
mark	inches	Original	Remold	Original	Remold
1	6	24	6	20	5
2	12	27	6	22	6
3	18	30	7	27	5
4	24	35	7	30	6
5	30	35	8	31	6

NOTES:

Figure 4.19. Diver's slate with vane shear data from example in Chapter 2.

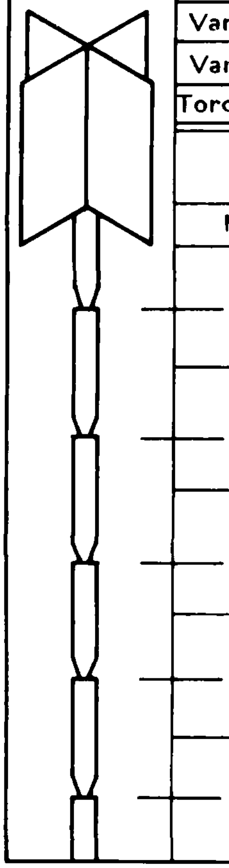
VANE SHEAR DATA SHEET

Project: Special Test Facility Project

Date: 12 Jun Time: 0830

Divers: Wright, Larabee

VANE SHEAR DATA FROM DIVER'S SLATE



Site + Data ID No.	AA-3	AA-4
Vane Size	Large	Large
Vane Serial No.	L-2	L-2
Torque Wrench Serial No.	08345	08545

DEPTH		TORQUE			
Mark	Inches	Original (in.-lb)	Remold (in.-lb)	Original (in.-lb)	Remold (in.-lb)
1	6	24	6	20	5
2	12	27	6	22	6
3	18	30	7	27	5
4	24	35	7	30	6
5	30	35	8	31	6

Observations:

Problems: no problems

Figure 4.20. Vane shear data sheet with data for Chapter 2 example.

VANE SHEAR
INSTRUCTION SHEET

(See Operation and Maintenance Manual for complete instructions)

I. SAFETY PRECAUTIONS:

1. For reliable data, check torque wrench calibration before each use.

II. ITEMS DIVERS NEED:

1. Torque wrench and socket
2. Set of three van shafts
3. Shaft with no vane on it
4. Babbit hammer (stiff soil)
5. MSPT anvil, hammer, and guide shaft (stiff soil)
6. Slate and pencil

III. TOOL ASSEMBLY:

1. Attach socket to torque wrench.
2. Check fit of socket on top of all vane shafts.
3. Check attachment of MSPT anvil to top of van shafts (screws on).

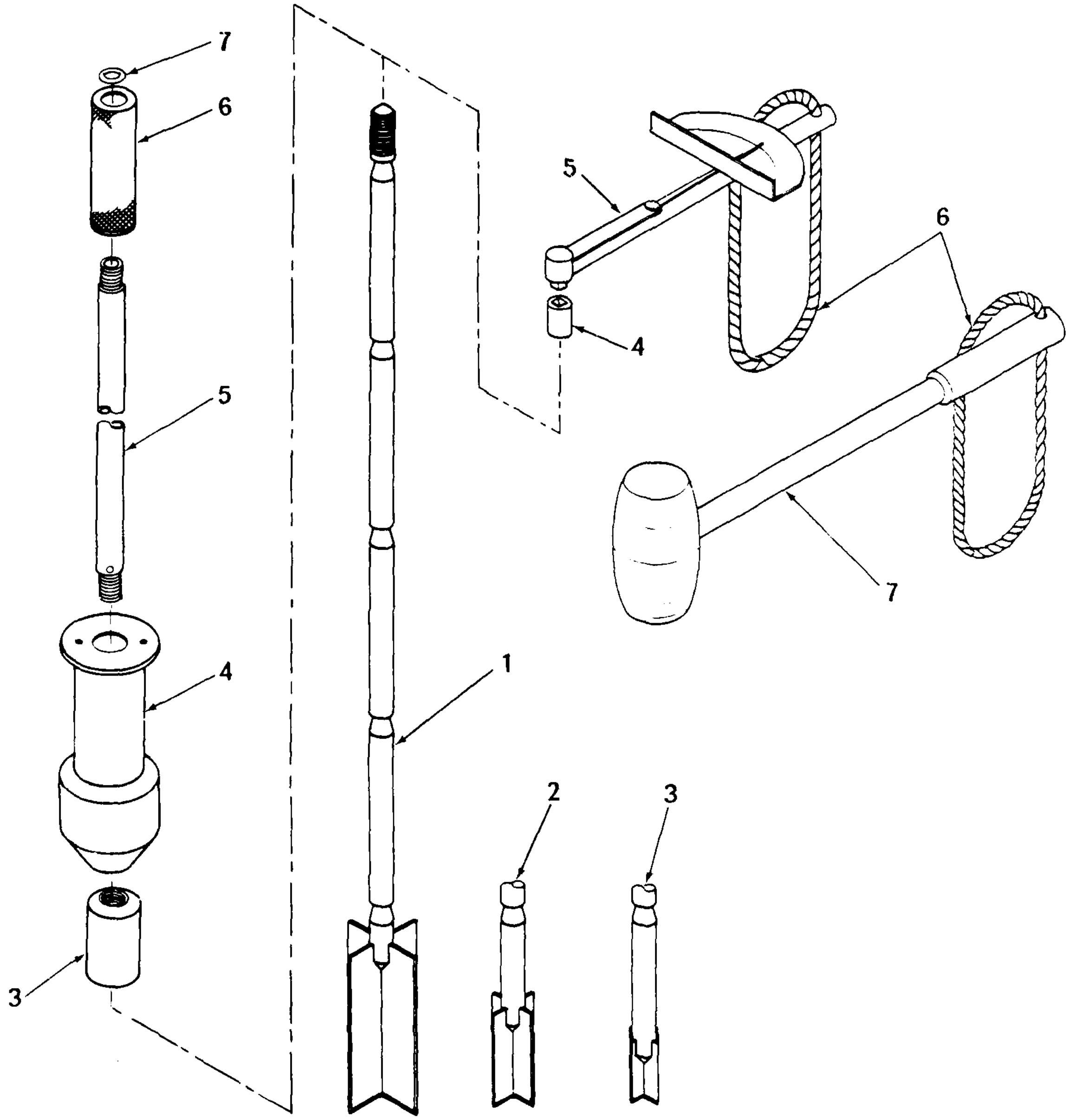
IV. TOOL OPERATION:

1. Start with largest vane (soft soil, large vane; stiff soil, small vane).
2. Insert vane into seafloor until first groove level with seafloor.
3. Attach torque wrench to shaft.
4. Set memory marker to zero.
5. Turn torque wrench very slowly clockwise until soil fails (usually in first 90°).
6. Read torque wrench and record on slate under "original."
7. Reattach torque wrench to vane and rotate vane through 10 turns to remold soil (do not push vane in deeper).
8. Zero memory marker on torque wrench.
9. Turn torque wrench very slowly clockwise until soil fails.
10. Read torque wrench and record on slate under "remold."
11. Push vane shaft in until next groove is level with seafloor.
12. Repeat steps 3 through 11 until full 30-inch penetration is reached.
13. If soil is stiff, use babbit hammer to hammer vane in (use only soft lead hammer to prevent damage to threads and top of vane shaft).
14. If vane shaft is stuck in soil; attach MSPT anvil, hammer, and guide shaft to vane shaft and hammer vane shaft out.
15. If torque wrench reads 50 in.-lb, switch to next smaller vane.
16. Clean tool when through.

V. DATA OBTAINED:

1. Original vane data as torque in inch-pounds and remolded vane data as torque in inch-pounds for five intervals (30 inches into seafloor).
2. See manual to convert torque (in.-lb) to vane shear strength (psi).

Figure 4.21. Summary instruction sheet for vane shear.



Tool	Part No.	Description	Tool	Part No.	Description
4	1	Vane shaft (2-1/2 x 5 in.)	5	3	Drive head (MSPT)
	2	Vane shaft (1-1/2 x 3 in.)		4	Hammer (MSPT)
	3	Vane shaft (1 x 2 in.)		5	Hammer guide shaft (MSPT)
	4	Socket		6	Handle (MSPT)
	5	Torque wrench		7	O-ring (MSPT)
	6	Cord			
	7	Babbit hammer			

VANE SHEAR INSTRUCTION SHEET

4.4 SCHEDULED MAINTENANCE

4.4.1 Introduction

Maintenance on the vane shear tool is performed periodically during storage, before use, and after use. Maintenance procedures for after use are listed below. Maintenance during storage and before use are the same with a few exceptions, which are noted.

4.4.2 After-Use Maintenance

The following maintenance steps should be performed after each use of the vane shear tool.

AFTER-USE MAINTENANCE STEPS:

1. Take tool apart; separate the vane shafts, socket, and torque wrench.

2. Wash all parts with freshwater, using wire brush as necessary to remove all soil and saltwater (Figure 4.22).

3. Apply lubricant/rust preventative, such as LPS-3, to all parts and all metal items in kit with a terry towel (Figure 4.23).

4. Place all parts in vane shear tool kit box.

4.4.3 During-Storage Maintenance

During-storage maintenance for the vane shear tool is the same as the steps for after-use maintenance. Steps 1 and 2 may be omitted if it appears that the tool is already clean. All items in the kit should be stored clean, dry, and properly cared for.

4.4.4 Before-Use Maintenance

Before-use maintenance is the same as that for after use with the exception of steps 1 and 2 if the tool appears to be clean. Two more steps should be added as follow:

5. Check calibration of torque wrench before use using the torque tester (see Section 4.3.2.).

6. Measure the height and the diameter (twice, second time 90 degrees from first) of

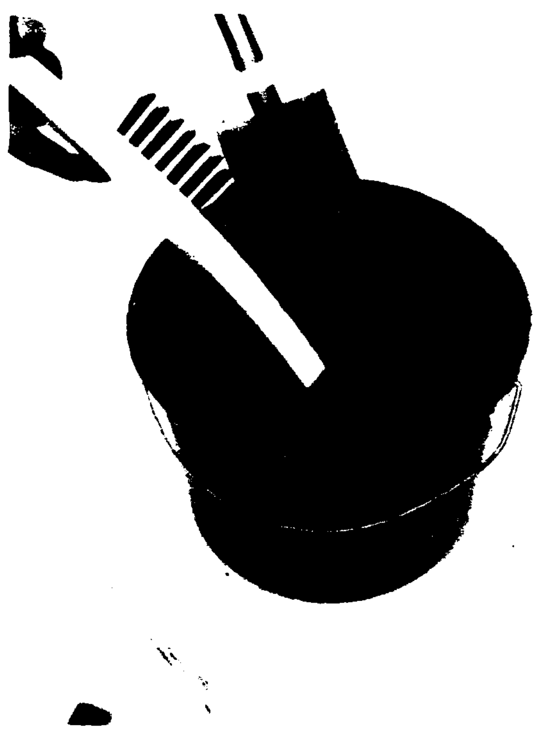


Figure 4.22. Cleaning soil off vane.

Figure 4.23. Applying rust preventative.

the vanes with a micrometer (Figures 4.24a and b) and note any difference in size from that shown in the shop drawings (Figure 4.30). If the vane size is off by 0.03 (1/32) inch, or if it shows signs of being worn, warped (bent), or nicked, it should be replaced.

4.5 TROUBLESHOOTING

This section presents some of the common problems that might occur in the operation of the vane shear tool. The troubleshooting procedures are listed in Table 4.1. See Section 4.6 for corrective maintenance procedures.

4.6 CORRECTIVE MAINTENANCE

4.6.1 Introduction

This section describes specific corrective maintenance for field maintenance of the vane shear tool.

4.6.2 Torque Wrench

If the torque wrench does not seem to be reading correctly based on calibration test results, the only way to correct the situation is to use a new torque wrench.

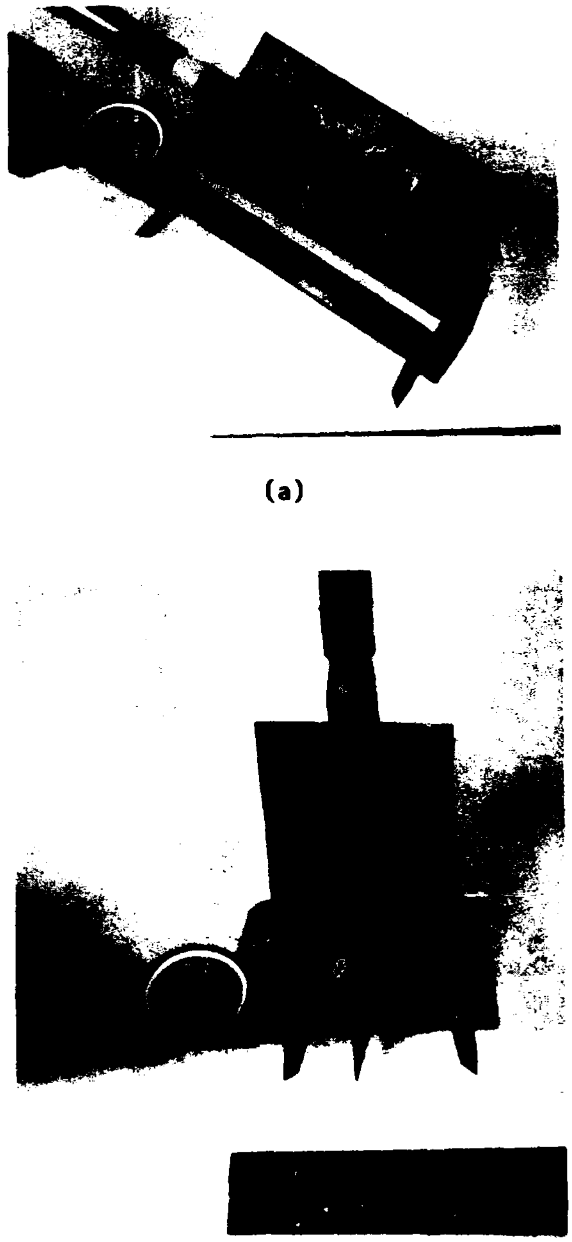
4.7 ILLUSTRATED PARTS BREAKDOWN - VANE SHEAR TOOL

4.7.1 Introduction

This section contains the illustrated parts breakdown (IPB) for the vane shear tool. The IPB consists of a parts list (Table 4.2) and an illustration (Figure 4.25). The parts in the list are indexed to the illustration, and the indexing reflects the disassembly sequence.

4.7.2 Parts List

The parts list (Table 4.2) includes all major components, assemblies, and detail parts for the vane shear tool. Each illustrated part shown disassembled in Figure 4.25 is assigned an index number. Parts shown as assemblies are listed (whenever possible) with



(a)

(b)

Figure 4.24. Measuring vanes with calipers.

Table 4.1. Troubleshooting - Vane Shear Tool

Problem	Probable Cause	Corrective Action
Torque wrench reads 50 in.-lb	1. Memory marker not set at zero before test	1. Move vane over and repeat that test (after rest of first series of tests is completed to full 30 in.)
	2. Soil may be too stiff; torque wrench reaches maximum before soil fails	2. Try next size smaller vane
Vanes will not penetrate soil	1. Soil conditions at site are beyond capability of tool	1. Try to get a soil sample, possibly with impact corer, for laboratory analysis
	2. May have hit a rock	2. Move over about 1 ft and try again
Torque readings vary by a large amount	1. Torque wrench not reading accurately	1. Check calibration or try another torque wrench
	2. Soil may be very layered	2. Take a core nearby and look for layers; send core to laboratory for layer identification

Table 4.2. Parts List - Vane Shear

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
4.25-0		82-2-1F	1	VANE SHEAR (FOR NHA SEE FIG ____)	80091	REF	
4.25-1		82-3-1F-1	2	VANE SHEAR ASSY	80091	1	
4.25-2		82-3-1F-2	2	VANE SHEAR ASSY	80091	1	
4.25-3		82-3-1F-3	2	VANE SHEAR ASSY	80091	1	
4.25-4		82-2-1F-12	2	SOCKET, 1/2 IN., 6 PT, 3.8-IN. DRIVE	80091	1	
4.25-5		5358A55	2	WRENCH, TORQUE, SQ BEAM WITH MEMORY	39428	1	
4.25-6		82-2-1F-13	2	CORD, 1/8 IN. DIA, 3 FT L (NYLON)	80091	1	
4.25-7		5910A9	2	HAMMER, BABBIT	39428	1	
4.25-8		82-2-1F-1,2,3	2	VANELESS SHAFT	80091	1	

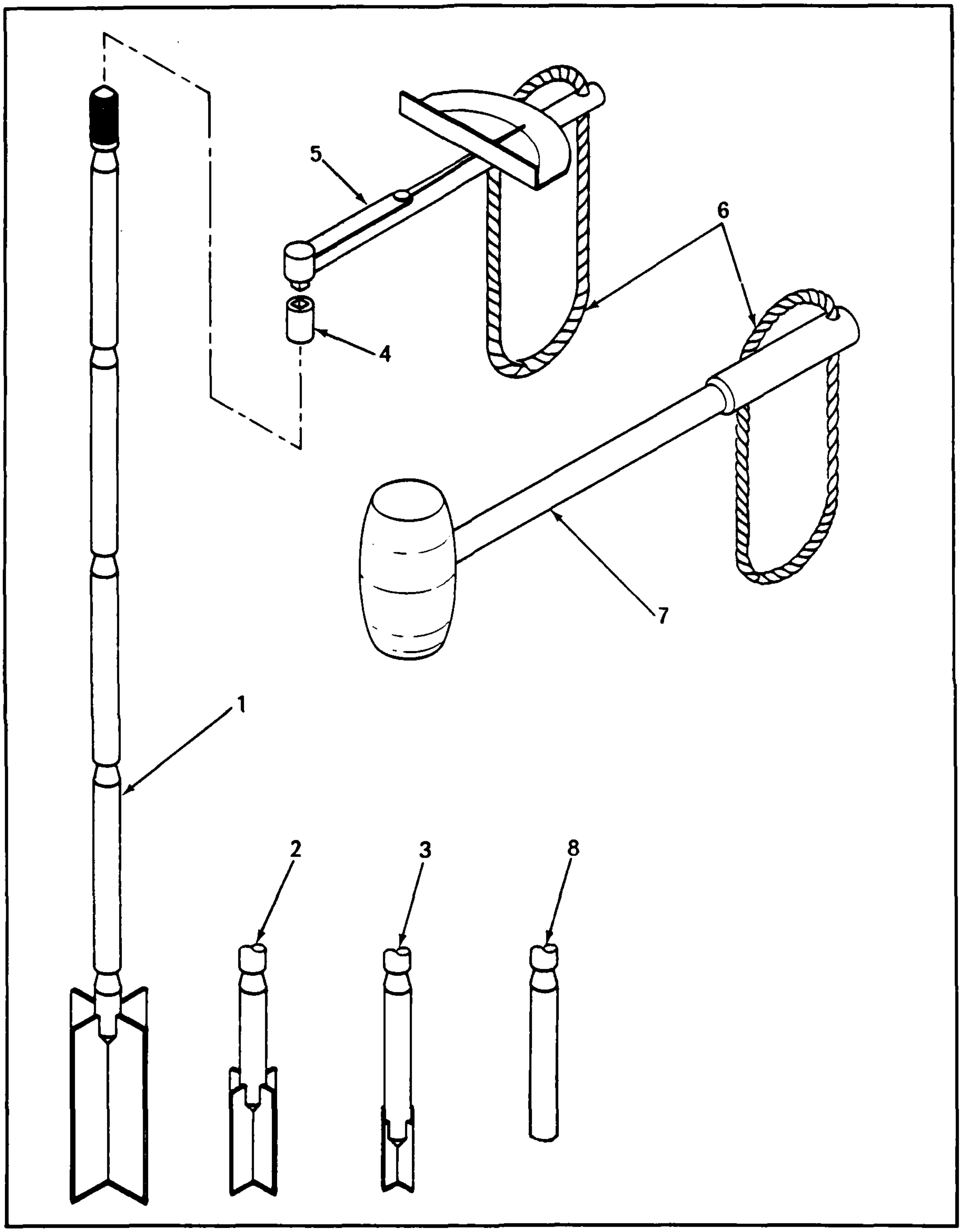


Figure 4.25. Vane shear.

reference to the figure number that shows the part disassembled.

4.7.2.1 **Figure and Index Number Column.** The figure and index number column list is in numerical order. The figure and index number of each part is shown on the corresponding illustration.

4.7.2.2 **Reference Designation Column.** The reference designation column will remain blank because there are no designated electrical or electronic parts for the vane shear tool.

4.7.2.3 **Part Number Column.** The part number column lists the manufacturer or Government part number for all parts shown in the applicable drawings. An entry of COML designates that the part or material is generally available through a variety of commercial sources or vendors. This column may also contain a NO NUMBER entry, indicating that the part has no applicable part number but is identified for procurement by the data in the description column.

4.7.2.4 **Indent Column.** The numbers 1 through 3 in the indent column show the relationship of parts and subassemblies to assemblies and/or installations. For any given figure, a number 1 indent item is the top level of an assembly or installation, and a number 3 indent is the lowest level of disassembly.

4.7.2.5 **Description Column.** The description column contains descriptions of all parts listed in the applicable drawings. Modifiers are included to identify the characteristics of a particular item. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference. A cross-reference appears both in the listing where the assembly is first described and in the listing in which the assembly is broken down. In the latter, the abbreviation REF appears in the quantity per assembly column. Abbreviations in the description column are generally in accordance with MIL-STD-12C and/or as noted in the list of abbreviations and acronyms.

4.7.2.6 **Manufacturer's Code Column.** The manufacturer's code column lists numbers identifying the suppliers of the parts. Table 4.3 lists both suppliers and codes, which are also available in the Federal Supply Code for Manufacturers, Cataloging Handbooks H4-1 and H4-2.

4.7.2.7 **Quantity Per Assembly Column.** The quantity per assembly column contains one of the following entries: a numeral indicating the quantity of the item used only at the indicated location or the abbreviation REF, indicating that the required quantity is listed on the figure referenced in the description column.

4.7.2.8 **Used-On Code Column.** This column will remain blank because there are no used-on codes applicable to this parts list.

4.7.3 Abbreviations and Acronyms

The abbreviations and acronyms listed in Table 4.4 appear in the parts list and in the text of this manual. Abbreviations used in the text may be in lower case letters, initial capitals with lower case letters, or all capitals. Abbreviations used in the parts list are in all capitals. The abbreviations and acronyms listed in Table 4.4 are in all capitals for consistency.

4.8 TOOL KIT

4.8.1 Introduction

This section explains the function of the vane shear tool kit and presents a list of the kit contents and the purpose of each item. Procurement information is given in Section 4.11. An Illustrated Parts Breakdown for the tool is given in Section 4.7.

4.8.2 Tool Kit Function

The vane shear tool kit is designed to be self-sufficient in the field with the exception of a source of freshwater for washing down the tool. The vane shear tool kit is packaged in the same box as the MSPT tool kit since some of the items are used with both. This box

Table 4.3. List of Manufacturers' Codes, Names, and Addresses

Code	Name and Address
02697	Parker-Hannifin Corporation Seal Group, O-Ring Division 2360 Palumo Drive Lexington, KY 40509
30781	Parker-Hannifin Corporation Packing Division 2220 S. 3600 W. Salt Lake City, UT 84119
31995	Jenkins Bros. 101 Merritt 7 Norwalk, CT 06851
35708	Textron Canada LTD Homelite-Terry Division 180 Labrosse Avenue P.O. Box 1800 Pointe Claire, Que Can H9R 4R6
39428	McMaster-Carr Supply Company P.O. Box 4355 Chicago, IL 60680
75336	Kingston F.C. Company 1007 N. Main Street Los Angeles, CA 90012
80091	Naval Facilities Engineering Command Washington, DC 20370
80094	Smith Herman H., Inc. 1913 Atlantic Avenue Manasquan, NJ 08736
81646	Ideal Corporation Sub of Parker-Hannifin Corporation 1000 Pennsylvania Avenue Brooklyn, NY 11207
95760	Protective Closures Company, Inc. 2150 Elmwood Avenue Buffalo, NY 14207
98773	Soiltest, Inc. 2205 W. Lee Street Evanston, IL 60202

Table 4.4. List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AP	Attaching Part
ASSY	Assembly
ASTM	American Society for Testing and Materials
COML	Commercial
CONN	Connector
CRES	Corrosion Resistant Steel
DEG	Degree
DIA	Diameter
EXT	Extension
FEM	Female
FIG	Figure
FT	Feet
GA	Gage
GAPL	Group Assembly Parts List
ID	Inside Diameter
IN.	Inch/Inches
INSTL	Installation
IPB	Illustrated Parts Breakdown
L	Long
MSPT	Miniature Standard Penetration Test
NHA	Next Higher Assembly
NPT	National Taper Pipe (Thread)
OD	Outside Diameter
PT	Point
PVC	Polyvinyl Chloride
REF	Referenced
SQ	Square
SS	Stainless Steel
ST	Street
STD	Standard
SUBASSY	Subassembly
THD	Thread

is of plywood construction, 4 feet long, 2 feet wide, and 1.4 feet tall for a total cube of 11.3 ft^3. The complete box weighs 146 pounds when fully equipped. The kit contains all the spare, repair parts, and supplies to operate the tool in the field (Figure 4.26).

Figure 4.26. Vane shear kit contents.

4.8.3 Tool Kit Contents

A list of the tool kit contents is shown in Table 4.5. The kit contents are listed as they are placed in the box, from bottom (Figure 4.27) to top (Figure 4.28) and from back to front. A brief explanation of the function of each item in the kit is given in Table 4.6.

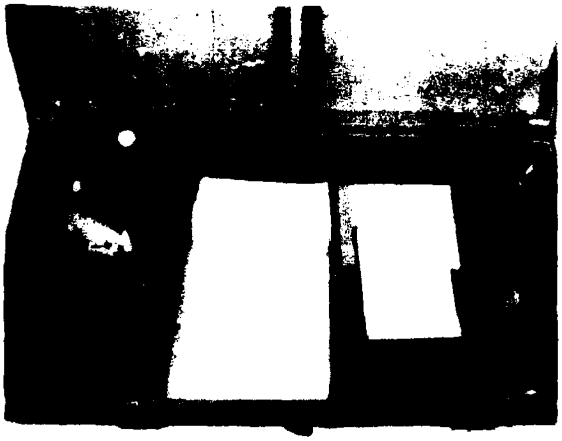


Figure 4.27. Bottom vane shear kit.

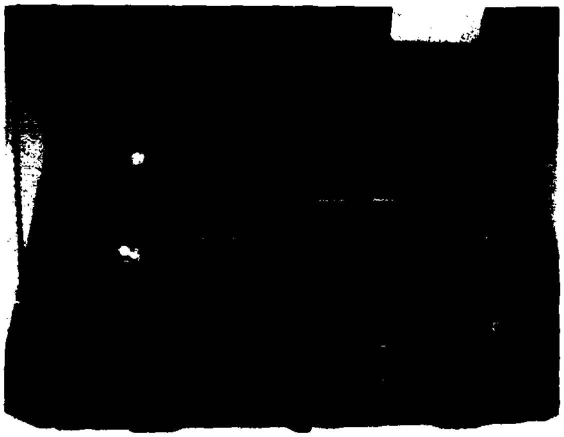


Figure 4.28. Top vane shear kit.

4.9 SHIPPING AND STORAGE

4.9.1 Introduction

The vane shear tool is designed to be stored in the kit box. The contents of the kits were selected to allow the kit to be shipped by commercial and military truck, ship, and aircraft. Shipping regulations change over time, so current regulations should be checked before shipping the box.

4.9.2 Storage

Contents of the kit shall be prepared for storage by ensuring that all metal parts have been cleaned and are sprayed with a rust preventative.

4.9.3 Shipping

Current shipping regulations should be checked before shipping the vane shear tool kit. The only item in the vane shear kit that requires special care for shipping is the lubricant/rust preventative LPS-3. Special packaging and permits can be avoided by using LPS-3 in bulk form. It is the aerosol packaging of this substance that requires it to be treated differently. By using bulk LPS-3,

Table 4.5. List of Contents - MSPT/Vane Shear Kit

Item	Kit Contents		Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier	Manufacturer/Supplier Part Number
	No.	Description						
1	1	Kit box	4.31/5.27	--	83-26-1F		Local carpenter shop	
2	1	LPS-3 (1 gal bulk)					Local supplier	
3	1	Spray bottle - LPS-3						FSN 8125-00-488-7952
4	1	Spray bottle - water						FSN 8125-00-488-7952
5	1	Never-Seize						FSN 8030-00-180-6187
6	1	Silicone grease						FSN 6850-00-880-7616
7	1	Plastic bucket (4 qt)						FSN 7240-00-061-1163
8	2	Terry towel (pkg)						FSN 7920-00-823-9772
9	1	MSPT-diver data slate	5.28				Local shop	
10	1	Vane shear-diver data slate	4.32				Local shop	
11	100	MSPT data sheets	B-7(5.13)				Local print shop	
12	100	Vane shear data sheets	B-6(4.18)					
13	5	Planning sheets	B-1					
14	5	Summary sheets	B-2					
15	5	Site data sheets	B-3					
16	5	Site sketch sheets	B-4					
17	5	Tool fail. & inadeq. report	B-10					
18	1	Bench vise, clamp base						FSN 5120-00-243-1372
19	2	Brass weight, 1 kg					Local scientific supply	
20	12	Pencils, #1						FSN 7510-00-286-5757
21	2	Erasers						FSN 7510-00-323-8788
22	10	O-rings	5.26	5.19-7	82-4-1F	7	Parker	
23	2	Cone shafts	5.26	5.19-1&2	82-4-1F	4,5	Local machinist	
24	1	Hammer guide tube	5.26	5.19-5,6,7	82-4-1F	1,2	Local machinist	
25	1	Hammer	5.26	5.19-4	82-4-1F	6	Local machinist	
26	1	Drive head	5.26	5.19-3	82-4-1F	3	Local machinist	
27	2	Torque wrenches	4.30	4.25-5	82-2-1F	11	McMaster-Carr	5358A55
28	2	Sockets- 3/8 drive	4.30	4.25-4	82-2-1F	12	Local supply/electroplater	
29	2	Babbit hammers	4.30	4.25-7	82-2-1F	14	McMaster-Carr	4910A9
30	1	Wire brush-stainless steel						FSN 7920-00-269-1259
31	1	Vane (1 x 2 in.) and shaft	4.30	4.25-3	82-2-1F	1	Local machinist	
32	1	Vane (1.5 x 3 in.) and shaft	4.30	4.25-2	82-2-1F	2	Local machinist	
33	1	Vane (2.5 x 5 in.) and shaft	4.30	4.25-1	82-2-1F	3	Local machinist	
34	1	Vaneless shaft	4.30	4.25-8	82-2-1F	(1,2,3)	Local machinist	
35	1	Summary instruction sheet (MSPT)	5.16				Local printer	
36	1	Summ. instruc. sht (vane sheer)	4.21				Local printer	
37	1	List of contents-MSPT/vane shear	Table 4.5 & 5.5				Local printer	

Table 4.6. Function of Kit Contents

Item	Description	Function in Kit
1	Kit box	Contain kit contents, shipping container
2	LPS-3 (bulk)	Rust preventative, lubricant for metal parts
3	Spray bottle - LPS-3	Apply bulk LPS-3
4	Spray bottle - water	Clean tool parts
5	Never-Seize	Lubricate threaded parts; prevent seizing and galling
6	Silicone grease	Lubricate O-ring; do not use other lubricants--they will deteriorate O-ring
7	Plastic bucket	Contain water for cleaning tools
8	Terry towels	Clean up tools, dry, and apply rust preventative
9	MSPT slate	Record MSPT data underwater--use #1 pencil; erase with pencil eraser
10	Vane shear slate	Record vane shear data underwater--use pencil only
11	MSPT data sheets	Permanent record of data--transfer data from slate to data sheet; reuse slate
12	Vane shear data sheet	Permanent record of data--transfer from slate to data sheet, erase, and reuse slate
13	Planning sheet	Plan geotechnical site survey (see Chapter 2)
14	Summary sheet	Summarize site survey (see Chapter 2)
15	Site data sheet	Record data location coordinates (see Chapter 2)
16	Site sketch sheet	Lay out site and mark and label data locations (see Chapter 2)
17	Tool fail. & inadeq. report	Report problems with tools and kits
18	Bench vise	Test torque wrenches for correct reading (see Section 4.3.2)
19	Brass weights, 1 kg	Test torque wrenches (see Section 4.3.2)
20	Pencils	Write on slates, data sheets
21	Erasers	Clean slates
22	O-ring	Lock cone shaft into MSPT handle
23	Cone shaft	Penetrate seafloor (see Section 5.2.4.2)
24	Hammer guide tube	Hammer drops along (see Section 5.2.4.4)
25	Hammer	Delivers exact amount of energy to cone shaft to cause penetration (see Section 5.2.4.1)
26	Drive head	Hammer falls on (see Section 5.2.4.3)
27	Torque wrench	Turns vane shaft; measures torque (see Section 4.2.4.4)
28	Socket	Quick connection between torque wrench and vane shaft (see Section 4.2.4.3)
29	Babbit hammer	Soft hammer to drive in cone shaft; does not deform end of shaft
30	Wire brush	Clean soil from tools
31	Vane - 1 x 2 in.	Determine vane shear strength (see Sections 4.2.4.1 & 2)
32	Vane - 1.5 x 3 in.	Determine vane shear strength (see Sections 4.2.4.1 & 2)
33	Vane - 2.5 x 5 in.	Determine vane shear strength (see Sections 4.2.4.1 & 2)
34	Vaneless shaft	Measure friction due to shaft only
35	Summary inst.-MSPT	Quick reference field guide
36	Summary inst.-vane shear	Quick reference field guide
37	List of contents-MSPT/vane shear	Guide to pack kit contents; replace contents

the kit falls in the category of a combustible liquid. All that is required is marking the box "COMBUSTIBLE LIQUID."

For shipping, the cube and weight of the packaging is given below:

MSPT/Vane Shear Kit	$11.3 ft^3$	146 lb

4.10 DATA ANALYSIS

4.10.1 Introduction

The equation necessary to convert the torque measured by the vane shear tool into vane shear strength for a cohesive soil is presented below. Part of the theory behind the equation is in Section 4.2.4.1.

4.10.2 Vane Shear Strength

The equation to convert the torque measured by the vane shear tool into vane shear strength is from the American Society for Testing and Materials (ASTM) Standard Method for Field Vane Shear Test in Cohesive Soil; ASTM D2573-72 (reapproved 1978). This equation is given below:

$$S_v = T\left[\frac{2}{\pi d^2 h\left(1 + \frac{d}{3h}\right)}\right]$$

where S_v = vane shear strength (psi)
T = torque (in-lb)
d = diameter of vane (in.)
h = height of vane (in.)

Since everything in brackets depends only on the dimensions of the vane, this quantity can be called a vane constant, K; the above equation can be simplified to:

$$S_v = T \times K$$

$$\text{where} \quad K = \left[\frac{2}{\pi d^2 h\left(1 + \frac{d}{3h}\right)}\right]$$

By calculating the vane constant for the three vanes in the geotechnical diver tool kit, the vane shear equation can be simplified to the following:

LARGE VANE (d = 2.5 in., h = 5 in.)	S_v (psi) = (0.01747)T (in.-lb)
MEDIUM VANE (d = 1.5 in., h = 3 in.)	S_v (psi) = (0.08088) T (in.-lb)
SMALL VANE (d = 1 in., h = 2 in.)	S_v (psi) = (0.27298) T (in.-lb)
SHAFT (vaneless)	S_v (psi) = (1.30380) T (in.-lb)

When using the smallest vane, some of the torque measured is due to friction on the vane shaft. Engineering judgment should be used with data taken with it. For the larger vanes, the soil has been disturbed by the vane tests performed above the present location of the vane so much that the soil around the shaft probably offers minimal resistance to the shaft.

4.10.3 Sensitivity

The sensitivity of a cohesive soil is the ratio of the *original strength measured and* the remolded strength measured after the soil was disturbed. This is very important information for some cohesive soils because the remolded strength is always less than the original strength, sometimes much less. This means that if something is to be placed on a cohesive soil that will disturb it, the strength it will have is less than the original measured shear strength.

The equation for sensitivity is given below:

$$S = \frac{\text{original vane shear strength}}{\text{remolded vane shear strength}}$$

The range of sensitivity for soils is given in the chart below:

Soil Description	S
Insensitive	2
Clay	2-4
Sensitive clay	4-8
Very sensitive clay	8-16
Slightly quick clay	16-32

Soil Description	S
Medium quick clay	32-64
Quick clay	64
Highly flocculent marine clay	10-80

4.11 PROCUREMENT INFORMATION

4.11.1 Introduction

All the necessary information to procure the vane shear diver tool, the MSPT/vane shear tool kit, and all the kit's contents is contained within this manual. The information can be found in the following locations:

Table 4.5	List of Contents - MSPT/ Vane Shear Kit
Section 4.7	Illustrated Parts Breakdown - Vane Shear Tool
Section 4.11.2	Purchase Description
Section 4.11.3	Manufacturers/Suppliers
Section 4.11.4	Drawings
Appendix B	Data Sheets

Table 4.5 can be used as a master list to procure anything in the kit. Within the table is information such as drawings, manual figure numbers, part numbers, and manufacturers.

4.11.2 Purchase Description

1. SCOPE. This purchase description establishes the requirements for the manufacture and acceptance of the geotechnical diver tools. These tools consist of a miniature standard penetration test (MSPT) device, vane shear, impact corer, vacuum corer, jet probe, and rock classifier.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this purchase description to the extent specified herein.

DRAWINGS

Figure No.	NCEL Drawing No.	Title
4.29	82-2-1F	Vane Shear Tool
4.30	83-26-1F	Kit Box for Vane Shear and MSPT
4.31	--	Diver Slate - Vane Shear

(Copies of drawings required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of Precedence. In the event of a conflict between the text of this purchase description and the references cited herein, the text of this purchase description shall take precedence.

3. REQUIREMENTS

3.1 Drawings. The drawings referenced in 2.1.2 are level 2 end-product drawings. No deviation from the prescribed dimensions or

tolerances is permissible without prior approval of the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation. Any data (such as shop drawings, layouts, flow sheets, and processing procedures) that are prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 Dimensions. All tool dimensions shall conform to the requirements specified in the end product drawings referenced in 2.1.2.

3.3 Materials. Materials shall be as specified herein and in other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this purchase description. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Materials shall conform to the requirements specified in the end product drawings listed in 2.1.2.

3.4 Workmanship. All parts, components, and assemblies of the geotechnical tools, including machined surfaces, seals, and welded parts, shall be clean and free from any defects in workmanship. External surfaces shall be free from burrs, slag, sharp edges, and corners except where sharp edges or corners are required.

3.5 Interchangeability. All parts referenced in the drawings in 2.1.2 that are described by the same part number shall be physically and functionally interchangeable.

3.6 Assembly. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.7 Threaded connections and fasteners. No threaded connections or fasteners shall show evidence of cross threading or mutilation.

3.8 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.9 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.10 Weights. Where indicated in drawings, weights of parts and subassemblies must be maintained within tolerances stated.

3.11 Seals. Where indicated in drawings, seals shall be installed with the necessary care required to maintain the watertight integrity of the tool.

3.12 Finish. All finishes shall conform to specifications shown in the drawings listed in 2.1.2 and shall be free from nicks, burrs, and surface defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The contractor is responsible for ensuring that components and materials used are manufactured, examined, and tested in accordance with the referenced sections of this purchase description. Each part, subassembly, and assembly shall be inspected according to the inspection requirements specified in Table I.

4.3 Inspection procedure.

4.3.1 Dimensional verification. All components shall be checked for conformance with the dimensions and tolerances specified in the drawings referenced in 2.1.2. Measurement shall be conducted using instruments capable of measurements of ±0.001 inch.

4.3.2 Visual inspection. Visual inspection shall be performed for compliance with material and workmanship requirements specified in the drawings referenced in 2.1.2.

4.3.3 Mechanical assembly. Component assembly shall be conducted to verify form, fit, and function of individual manufactured components.

4.3.4 Weighing. Components that have weights specified in the drawings referenced in 2.1.2 shall be checked using a standard certified scale capable of ±0.1 percent accuracy.

4.4 Inspection failure. Failure of production geotechnical tools to meet any requirement specified herein during and as a result of the specified inspection shall be cause for rejection of the production tools and shall be cause for refusal by the Government to continue acceptance of production tools until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

5. PREPARATION FOR SHIPMENT

5.1 Preservation and packaging. All parts and subassemblies shall be preserved and packaged in accordance with MIL-STD-1188.

4.11.3 Manufacturers/Suppliers.

Space is left for you to write in local suppliers.

NEDOX CR PLUS PLATE -

Suppliers:

General Magnaplate Corp.
2707 Palma
Ventura, CA 93003
(805) 642-6262

1331 U.S. Route 1
Linden, NJ 07036
(201) 862-6200

801 Avenue G East
Arlington, TX 76011
(817) 649-8989

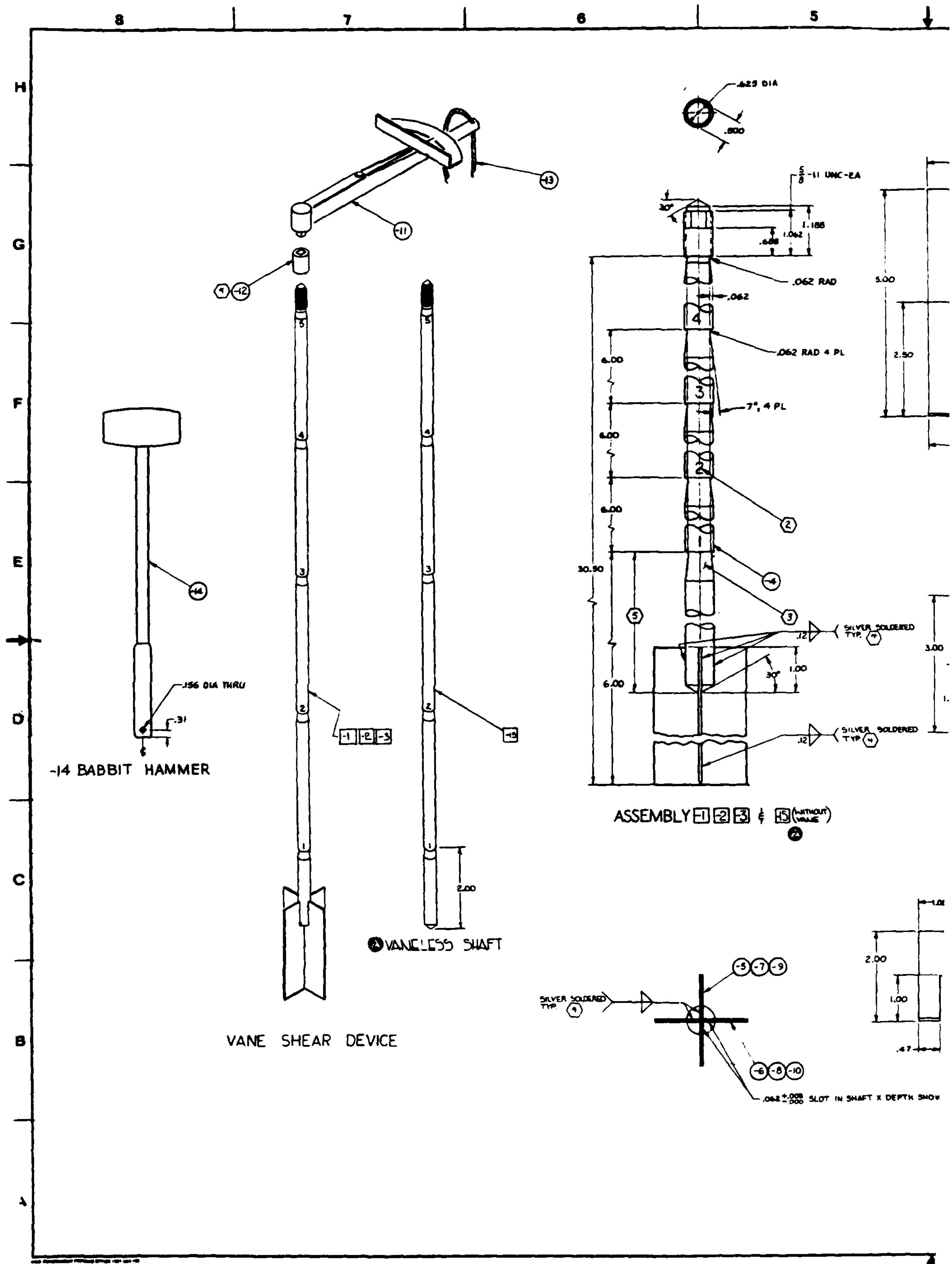
4.11.4 Drawings

The following drawings are included in this section:

Figure No.	NCEL Drawing No.	Title
4.29	82-2-1F	Vane Shear Tool
4.30	83-26-1F	Kit Box For Vane Shear and MSPT
4.31	--	Diver Slate - Vane Shear

Table I. Inspection and Test Requirements

Inspection	Number of Sample Units	Requirement Paragraph	Method Paragraph	Number of Failures Allowed
Dimensions not as specified	All units	3.2	4.3.1	None
Materials not as specified	All units	3.3	4.3.2	None
Workmanship not as specified	All units	3.4	4.3.2	None
Interchangeability	All units	3.5	4.3.1	None
Assembly	All units	3.6	4.3.3	None
Threaded connections and fasteners	All units	3.7	4.3.2	None
Welding	All units	3.8	4.3.2	None
Bolted connections	All units	3.9	4.3.2	None
Required component weights	All units	3.10	4.3.4	None
Seals	All units	3.11	4.3.2	None
Finish	All units	3.12	4.3.2	None


8
7
6
5
H
G
F
E
D
C
B
.625 DIA
.800
$\frac{5}{8}$-11 UNC-2A
30°
1.188
1.062
.688
.062 RAD
.062
.062 RAD 4 PL
7°, 4 PL
6.00
6.00
6.00
30.50
6.00
1.00
30°
.12
SILVER SOLDERED TYP.
SILVER SOLDERED TYP
5.00
2.50
3.00
2.00
1.00
.47
.156 DIA THRU
.31
-14 BABBIT HAMMER
-1 -2 -3
-15
2.00
VANELESS SHAFT
VANE SHEAR DEVICE
ASSEMBLY -1 -2 -3 & -15 (WITHOUT VANE)
-5 -7 -9
-6 -8 -10
.062 +.008 -.000 SLOT IN SHAFT X DEPTH SHOWN

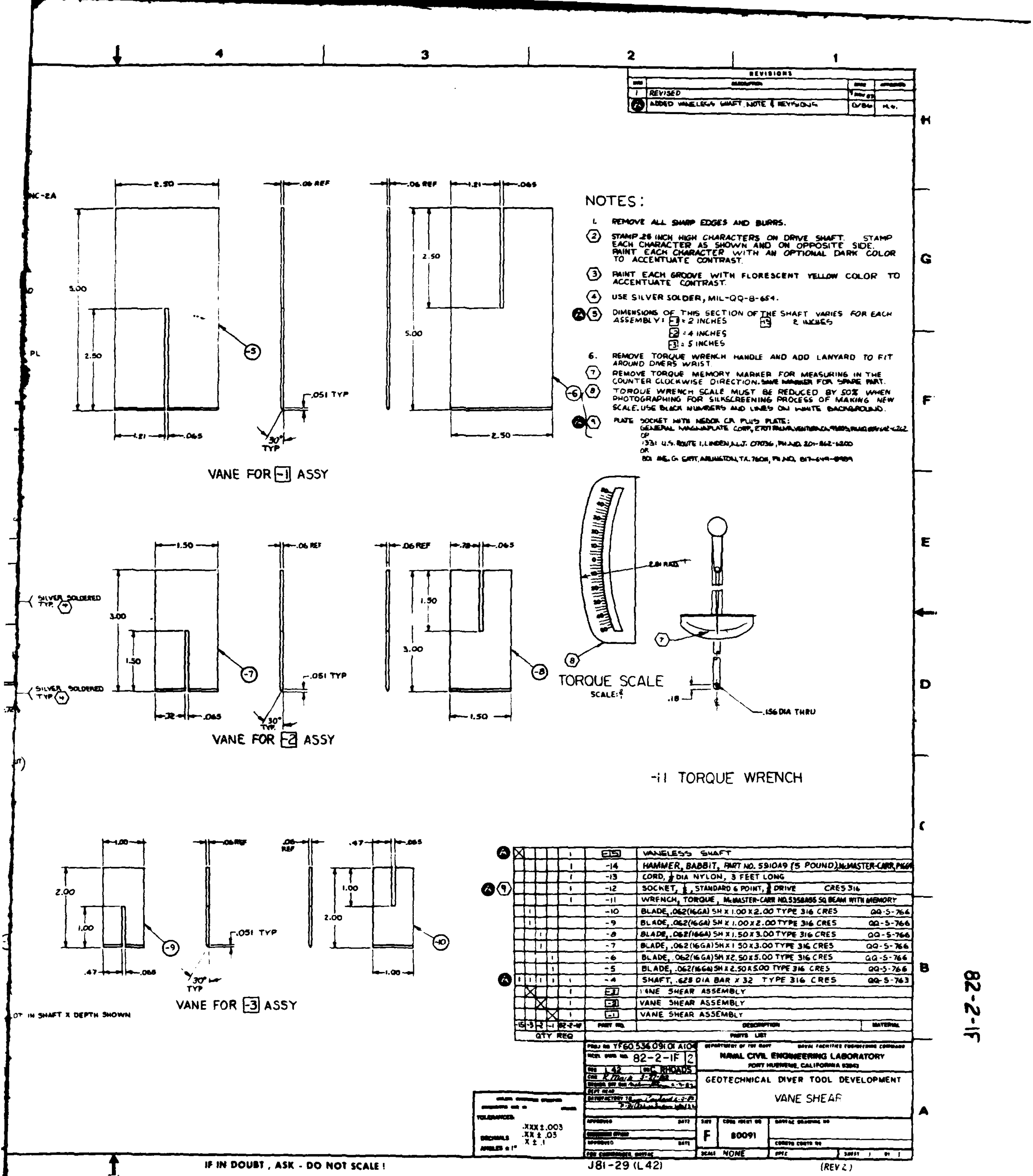
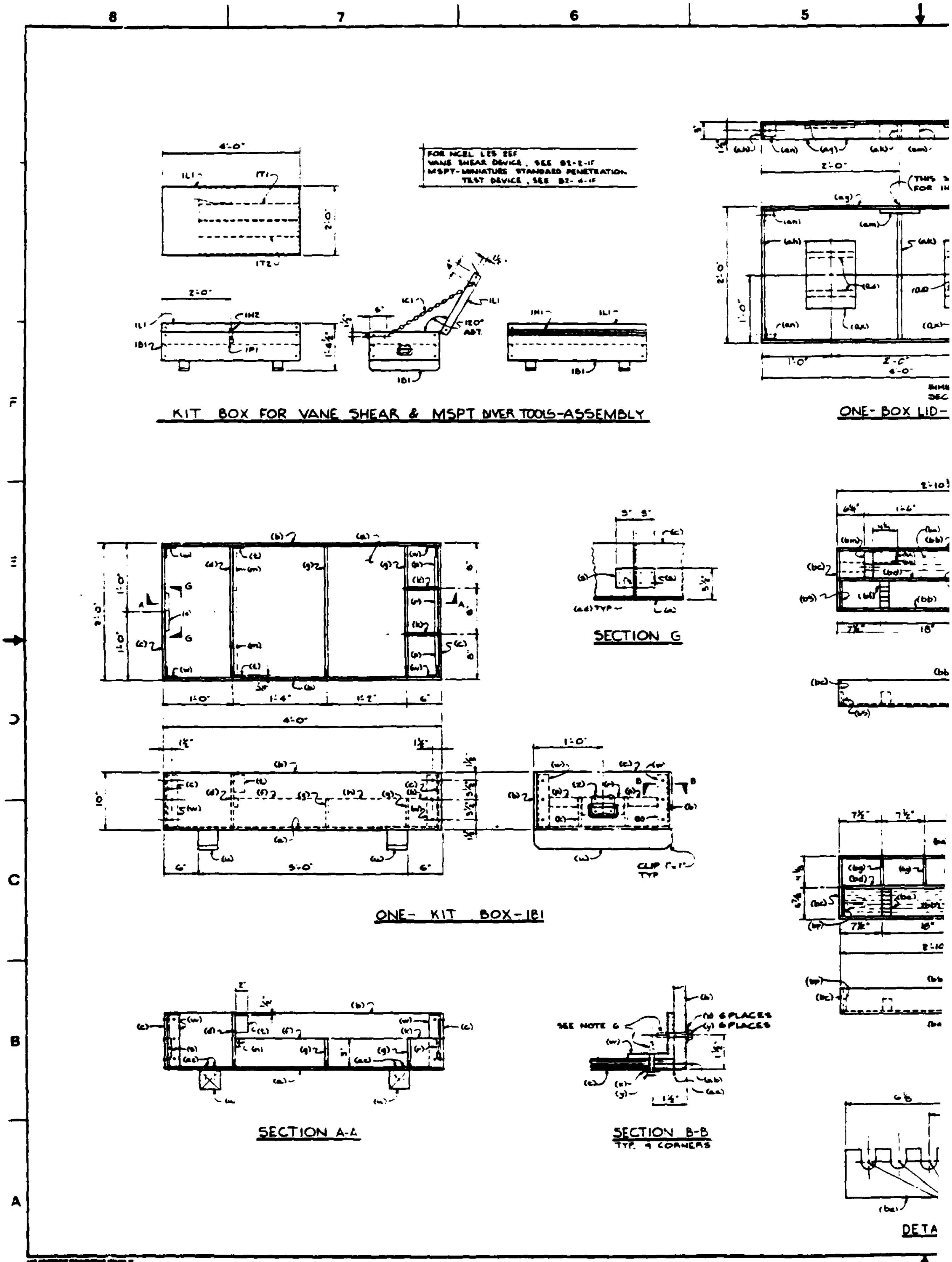


Figure 4.29. Vane shear.


8
7
6
5
FOR NCEL LES REF
VANE SHEAR DEVICE, SEE B2-2-1F
MSPT-MINIATURE STANDARD PENETRATION
TEST DEVICE, SEE B2-4-1F
KIT BOX FOR VANE SHEAR & MSPT DIVER TOOLS-ASSEMBLY
ONE- BOX LID-
SECTION G
ONE- KIT BOX-1B1
SECTION A-A
SECTION B-B
TYP. 4 CORNERS
SEE NOTE 6
6 PLACES
CLIP
TYP
DETA
C
B
A

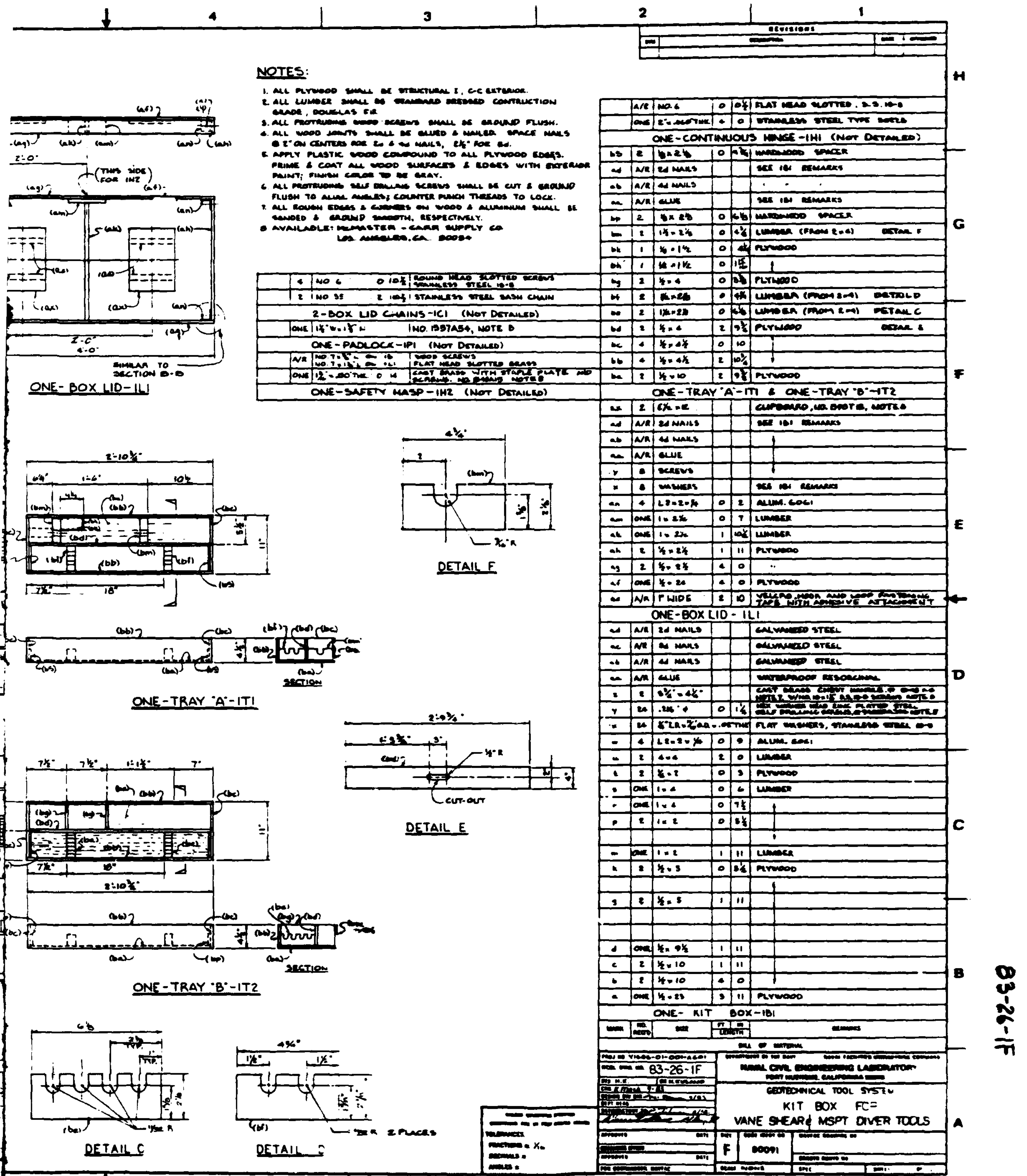
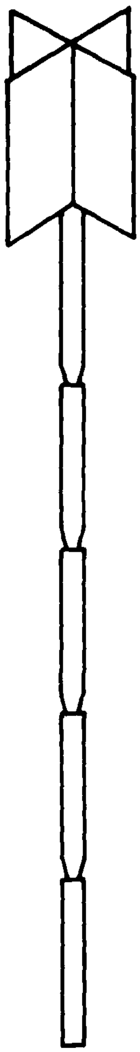


Figure 4.30. Kit box for vane shear and MSPT devices.

USE SOFT LEAD PENCIL ONLY

VANE SHEAR



Site & Data ID					
Vane Size					
Vane Serial #					
Torque Wrench Serial #					
DEPTH		TORQUE (in-lb)			
mark	inches	Original	Remold	Original	Remold
1	6				
2	12				
3	18				
4	24				
5	30				

NOTES:

Figure 4.31. Vane shear diver's slate. Engrave layout onto a 9x12x1/8-inch piece of white high-impact styrene plastic, leaving a 1-inch border all around. Paint with black paint, wipe off while wet leaving black paint in engraved areas. Drill hole at top center of slate to attach line for diver to tie slate on and to attach pencil.

CHAPTER 5

MINIATURE STANDARD PENETRATION TEST (MSPT)

5.1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

5.1.1 General Information

The MSPT is a hand-operated diver tool that takes in-situ penetration data in cohesionless soils at 3-inch intervals to a depth of 30 inches. A photograph of the MSPT is shown in Figure 5.1. The major parts of the tool are identified in the photograph. The tool is shown extended for use in the photograph. For storage and for easier handling, the cone shaft unscrews from the anvil and stores in the guide shaft for the hammer (Figure 5.2). The tool is 5 feet 8 inches long extended and 39 inches long when stowed. It weighs 17 pounds in air and 14 pounds in seawater. It takes about 10 minutes to take a set of data with the MSPT.

The MSPT is packaged as a kit together with the vane shear tool kit in a box. The kit contains the spare and repair parts for the MSPT tool and shares some of the support

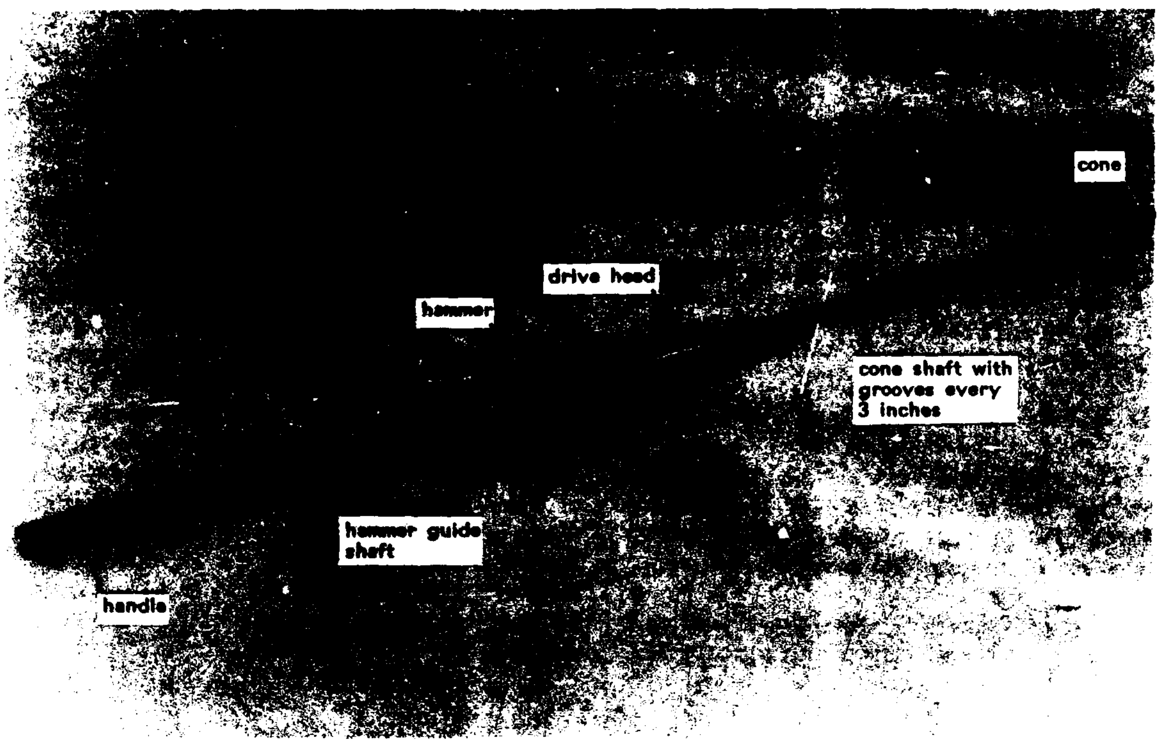


Figure 5.1. Miniature standard penetration test (MSPT) (extended).

Figure 5.2. MSPT with cone shaft stored in handle.

equipment with the vane shear tool kit. The box is 4 feet long, 2 feet wide, and 1.4 feet tall. It weighs 146 pounds fully equipped.

The geotechnical data taken with the MSPT are in-situ data in the form of hammer blow counts. The hammer on the tool is raised to the top of the guide shaft and then allowed to drop freely. The number of these hammer blows needed to drive the cone shaft into the soil 3 inches is recorded as the MSPT data. These data give an indication of the density of the soil and its consistency over the area. This tool is intended to be used only in cohesionless soils. Cohesionless soils are soils that do not stick together when rolled around in your hand (e.g., sand). Data can be taken in cohesive soils if the soil is firm. The MSPT will sink in soft soils due to its weight with no hammer blow counts.

5.1.2 Safety Precautions

The MSPT is a very simple tool; therefore, the tool presents few serious safety hazards. The only moving part during operation is the hammer. The precautions are:

1. Do not get fingers between drive head and hammer or between hammer and top of guide shaft.

2. Push cone shaft into hammer guide shaft until it is held in place by the O-ring when it is stored in this manner. If it is not held tight, it can fall out and cause injury as a spear.

3. Use cleaning solvents and lubricants in a well-ventilated area only. Avoid prolonged breathing of the fumes or contact with the skin.

5.2 FUNCTIONAL DESCRIPTION

5.2.1 Introduction

This section provides a functional description of the MSPT and the theory of operation.

5.2.2 Tool Function

The MSPT takes in-situ data in cohesionless soils. The data are in the form of hammer blow counts. These data can give an indication of the density of the soil and of the consistency of soil type and density with depth and over an area.

5.2.3 Functional Sequence

The MSPT is taken to the seafloor by the divers. The divers should determine beforehand if the soil is cohesionless and that the MSPT is the proper tool to use. The cone rod is taken out of the hammer guide shaft and screwed into the anvil. Diver #1 then stands the MSPT vertical with the cone tip resting on the seafloor and lets the tool sink into the soil under its own weight. This distance is recorded. Diver #2 puts his fingers on the cone shaft to feel for the grooves marking the 3-inch intervals. Diver #1 raises the hammer to the top of the guide shaft and lets it fall freely to the drive head. Diver #1 repeats this until diver #2 signals that the next groove has reached the level of the seafloor. The number of hammer blows needed to push the cone shaft in that 3-inch interval is the data that are recorded. This process is repeated until the tool penetrates the full 30 inches or until 50 hammer blows do not result in a 3-inch penetration.

5.2.4 Component Function and Theory of Operation

5.2.4.1 Hammer. The hammer provides a driving force, an impact, that pushes the cone into the soil. The in-air weight of the hammer should be checked periodically and should be 11.6 $\pm$0.1 pounds. If the weight differs from the 11.6 pounds, the tool will not be taking consistent data over time. It delivers an impact to the drive head, which pushes the cone shaft into the soil. This tool was based on a tool used on land for geotechnical in-situ testing called the Standard Penetration Test (STP). This test uses a 140-pound hammer that is dropped 30 inches to push a cone-tipped rod into the soil. Hammer blow counts, N, are counted each foot of cone penetration. Over time the use of the STP has resulted in a tremendous amount of data. Along with the blow counts, N, the number of failures of structures with designs based on N has also been noted. Based on this kind of data, a correlation has been made between N and soil properties, such as relative density and friction angle in cohesionless soils. The theory of operation of the MSPT is based on that of the STP; however, there is no direct correlation or scaling between them. Therefore, over time a correlation can be established by compiling geotechnical laboratory data and MSPT in-situ data for a variety of soils.

5.2.4.2 Cone Shaft. The cone shaft penetrates the soil and provides a means of measuring the depth of the cone in the seafloor. Along the cone shaft are grooves every 3 inches starting at the cone tip and going to the top of the shaft. These grooves were designed to be felt by a diver wearing a three-fingered wetsuit glove. The cone tip on the MSPT has an included angle of 30 degrees. This cone is not hollow and does not take a sample. A spare cone shaft is provided in the kit.

5.2.4.3 Drive Head. The drive head provides a hammering surface to drive the cone shaft into the soil and a connection between the hammer guide shaft and the cone shaft.

5.2.4.4 Hammer Guide Shaft. The hammer guide shaft provides a means of getting identical impacts delivered to the cone shaft by providing a measured, repeatable drop distance for the hammer. This repeatable drop distance is important in getting consistent data. Any change in drop distance will mean that a different amount of impact is delivered to the cone. This will result in incorrect data being recorded.

5.3 ASSEMBLY, OPERATION, AND DATA RECORDING

5.3.1 Introduction

This section explains step-by-step the assembly, operation, and data recording for the MSPT tool. Before the divers use the MSPT, they should determine if the soil is cohesionless. If there is any doubt, do the test anyway and take a sample for later laboratory determination of soil type. The impact corer can be used for this sampling, or a bulk sample saved in a plastic bag is better than nothing.

5.3.2 Assembly

The assembly steps for the MSPT are given below. Be sure to apply the proper lubricants as needed during assembly. Refer to the Illustrated Parts Breakdown (Section 5.7) to identify the parts.

ASSEMBLY STEPS

1. Slide the hammer onto the hammer guide shaft.

2. Screw the drive head onto the bottom of the hammer guide shaft, lubricating the threads with Never-Seize (Figure 5.3).

3. Lubricate the threads on the top of the cone shaft and those in the bottom of the anvil with Never-Seize.

4. Slide the cone shaft, thread end first, into the hammer guide shaft handle (Figure 5.4a). Push the cone down until the cone is held in

Figure 5.3. Lubricating threads.

place by the O-ring inside the guide shaft handle (Figure 5.4b). This O-ring should be lubricated with silicone grease.

5. Gather the following for the divers to take down with them (Figure 5.5):

MSPT tool
Data slate with pencil

5.3.3 Operation

The operation steps for the MSPT tool are listed below.

1. Divers swim down with the MSPT tool and data slate.

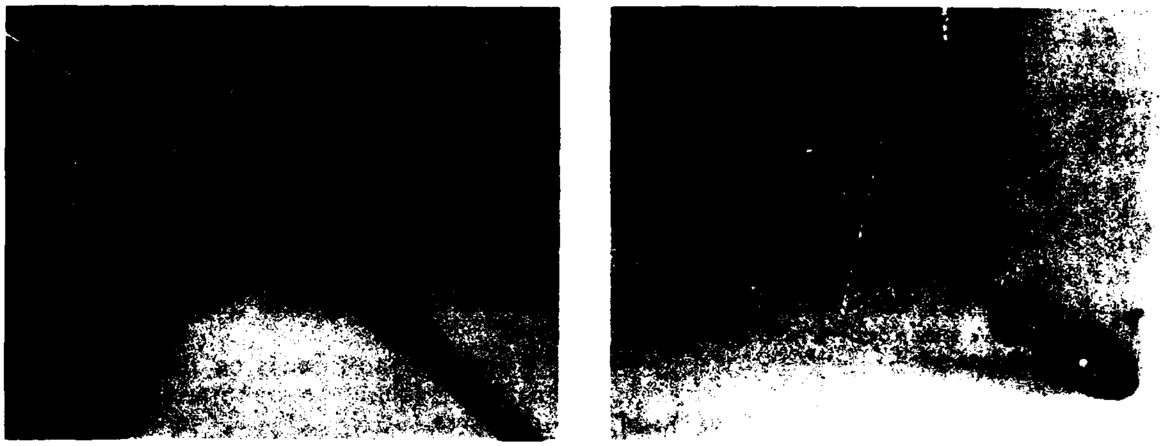
2. Pull the cone shaft out of storage in the hammer guide shaft (Figure 5.6) and screw into the bottom of the drive head (Figure 5.7).

3. Diver #1 stands the MSPT up vertical with the cone resting on seafloor and allows the cone to sink into the seafloor under its own weight (Figure 5.8).

4. Diver #2 observes the depth of embedment and records this on the slate.

5. Diver #2 puts his fingers on the cone shaft at the seafloor to feel for grooves marking the 3-inch increments (Figure 5.9).

6. Diver #1 raises the hammer to the top of the guide shaft and releases it, allowing the hammer to fall freely until it hits the drive head. Diver #1 repeats this, counting the number of hammer blows, until signaled by diver #2 that the next groove has reached the level of the seafloor.



(a) (b)

Figure 5.4. Storing cone shaft in handle.

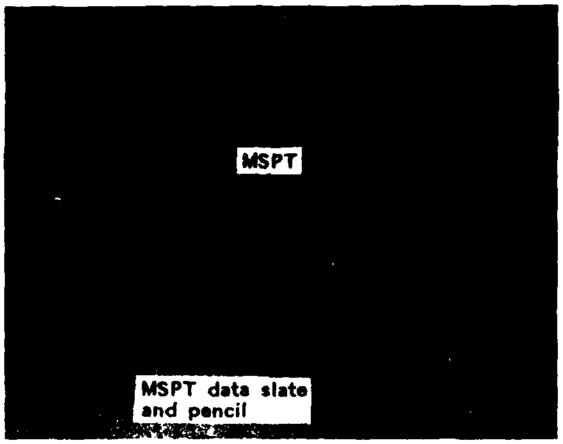


Figure 5.5. Diver's equipment.

Figure 5.7. Screwing cone shaft into drive head.

Figure 5.6. Removing cone shaft from handle.

Figure 5.8. Standing MSPT up.

Figure 5.9. Dropping hammer.

7. The number of hammer blow counts for the increment is recorded on the MSPT slate (use only a lead pencil) (Figure 5.10).

Figure 5.10. Recording data.

8. Steps 5 through 7 are repeated until the MSPT has penetrated 30 inches or until 50 blows do not result in at least 3 inches of penetration. This point is called refusal and should be noted on the slate.

9. If refusal is met before the cone shaft has penetrated halfway, move over a little and try again. You may have hit a rock.

10. When the full penetration of 30 inches or refusal has been reached, hammer the cone shaft out of the seafloor by hammering upward (Figure 5.11). Unscrew the cone shaft and insert it back into the hammer guide shaft, pushing it in to be sure it is held by the O-ring. If it is not, it may fall out while returning to the surface, presenting a hazard as a free-falling spear.

Figure 5.11. Hammering cone shatt out.

5.3.4 Data Recording

The data taken with the vane shear tool are recorded on the diver's slate and then later transferred to data sheets. The diver's slate is shown in Figure 5.12 and the data sheet in Figure 5.13. Use only a soft lead pencil on the slate; use a pencil eraser to clean the slate. The slate can be washed with cleanser soap and water. The data are recorded for each 3-inch increment as hammer blow counts. The counting starts over with one at the start of each new 3-inch increment. The slate and data sheet when filled out with data would look like those shown in Figures 5.14 and 5.15. For the analysis of these data, see Section 5.10.

5.3.5 Summary Instruction Sheet

The above instructions for the assembly and operation of the MSPT have been condensed to one page with an illustrated parts breakdown on the back side (Figure 5.16). A laminated copy of this page can be kept in the kit box for quick field reference. This one page of instructions is very brief, intended to function as a reminder, so the manual should be read first.

5.4 SCHEDULED MAINTENANCE

5.4.1 Introduction

Maintenance on the MSPT is performed periodically during storage, before, and after use. Maintenance procedures for after use are listed below. Maintenance during storage and before use is the same with a few exceptions, which are noted below.

5.4.2 After-Use Maintenance

The following maintenance steps should be performed after each use of the MSPT tool.

AFTER USE MAINTENANCE STEPS

1. Take the tool apart, unscrewing the cone shaft, drive head, and hammer guide shaft, and slide the hammer off.

2. Wash the tool with freshwater, using a wire brush to remove soil (Figure 5.17).

3. Dry the tool and coat with a rust preventative, such as LPS-3, using a terry towel; lubricate the threads with Never-Seize (Figure 5.18).

4. Store the MSPT in the kit box.

5. Clean and dry all kit contents. Coat all metal items with rust preventative.

5.4.3 During-Storage Maintenance

During-storage maintenance for the MSPT is the same as that for after use. Steps 1 and 2 may be omitted if the tool appears to be clean. A sixth step should be added as shown below.

5. Weigh the hammer and record the weight and date. If the hammer weight varies more than is allowed on the specifications (11.6 pounds = 0.1 pound), the weight should be corrected or the hammer replaced.

5.4.4 Before-Use Maintenance

Before-use maintenance is the same as that for during storage given above.

5.5 TROUBLESHOOTING

This section presents some of the common problems that might occur in the operation of the MSPT tool. The troubleshooting procedures are listed in Table 5.1. See Section 5.6 for corrective maintenance procedures.

5.6 CORRECTIVE MAINTENANCE

There are few corrective maintenance procedures for the MSPT that can be performed in the field. Those that are listed in Table 5.5 are self-explanatory. Look at the Illustrated Parts Breakdown (Section 5.7) for part identification.

5.7 ILLUSTRATED PARTS BREAKDOWN

5.7.1 Introduction

This section contains the illustrated parts breakdown (IPB) for the MSPT. The IPB

USE SOFT LEAD PENCIL ONLY

MSPT

Site & Data ID					
Hammer Serial#					
DEPTH		HAMMER BLOW COUNT			
mark	inches				
1	3				
2	6				
3	9				
4	12				
5	15				
6	18				
7	21				
8	24				
9	27				
10	30				

NOTES:

Figure 5.12. Diver's slate.

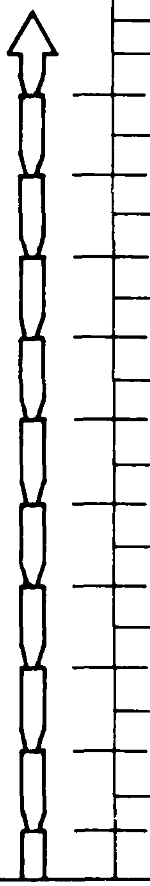
MSPT DATA SHEET

Project: ____________________

Date: ____________________ Time: ____________________

Divers: ____________________

MSPT DATA FROM DIVER'S SLATE



Site + Data ID No.					
Hammer Serial No.					
DEPTH		MSPT HAMMER BLOWS			
mark	inches				
1	3				
2	6				
3	9				
4	12				
5	15				
6	18				
7	21				
8	24				
9	27				
10	30				

Observations: ____________________

Problems: ____________________

Figure 5.13. MSPT data sheet.

USE SOFT LEAD PENCIL ONLY

MSPT

Site & Data ID		BA-22	BB-26	BC-30	BD-34
Hammer Serial#					
DEPTH		HAMMER BLOW COUNT			
mark	inches				
1	3				
2	6	7"	6"		3
3	9	2	2	9"	3
4	12	3	3	1	4
5	15	3	4	3	5
6	18	5	6	4	5
7	21	8	7	7	6
8	24	10	9	8	9
9	27	12	13	10	12
10	30	12	14	12	15

NOTES:

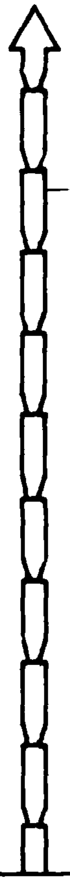
Figure 5.14. MSPT diver slate with data for example in Chapter 2.

MSPT DATA SHEET

Project: Special Test Facility Project

Date: 13 Jun Time: 0810

Divers: Smith, Jones



MSPT DATA FROM DIVER'S SLATE					
Site + Data ID No.		BA-22	BB-26	BC-30	BD-34
Hammer Serial No.					
DEPTH		MSPT HAMMER BLOWS			
mark	inches				
1	3	Sunk			↓ 3"
2	6	↓ 7"	↓ 6"		3
3	9	2	2	↓ 9"	3
4	12	3	3	1	4
5	15	3	4	3	5
6	18	5	6	4	5
7	21	8	7	7	6
8	24	10	9	8	9
9	27	12	13	10	12
10	30	12	14	12	15

Observations:

Problems:

Figure 5.15. MSPT data sheet filled out with data from examples in Chapter 2.

MSPT INSTRUCTION SHEET

(See Operation and Maintenance Manual for complete instructions.)

I. SAFETY PRECAUTIONS:

1. When cone shaft is stored inside hammer guide shaft, be sure it is held in place by the O-ring. If it is not properly seated, it can fall out and cause injury as a spear.

2. Do not get fingers between hammer and drive head or hammer and top of guide shaft.

II. ITEMS DIVERS NEED:

1. MSPT tool
2. MSPT data slate
3. Pencil

III. TOOL ASSEMBLY:

1. Lubricate all threads with Never-Seez.
2. Slide hammer on guide shaft.
3. Screw drive head onto guide shaft.
4. Slip cone shaft into hammer guide shaft and seat.

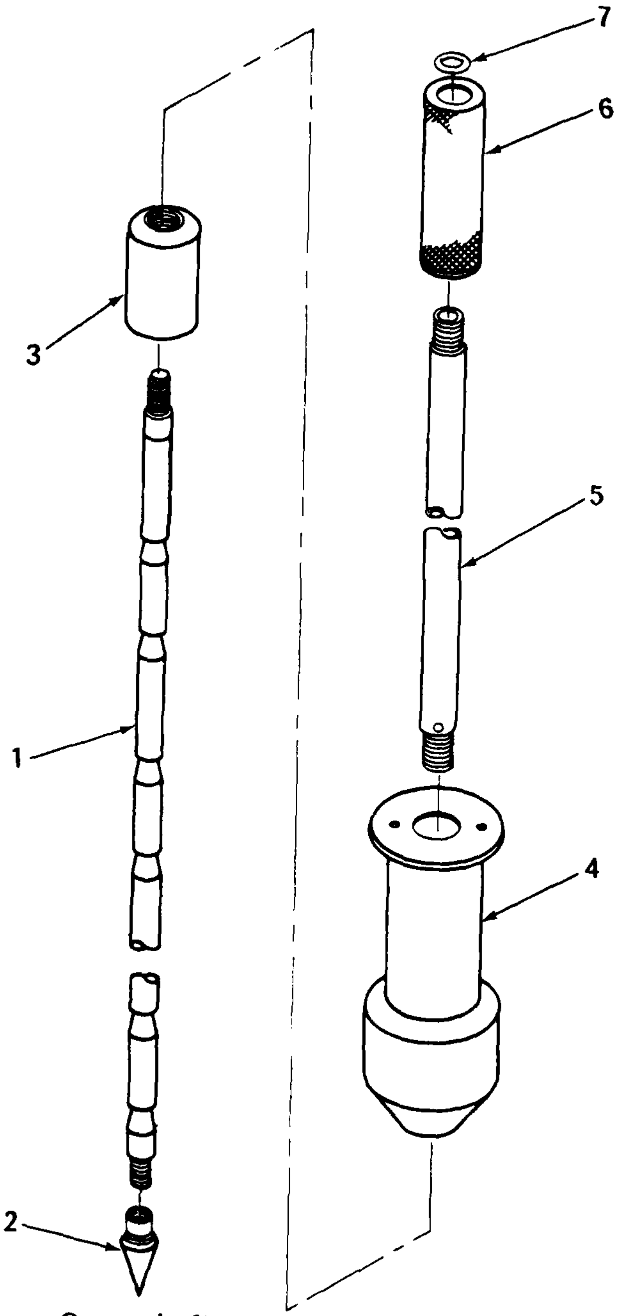
IV. TOOL OPERATION:

1. Remove cone shaft from handle of guide shaft.
2. Screw cone shaft into bottom of drive head.
3. Stand up MSPT, cone into seafloor.
4. Let cone sink into seafloor under its own weight.
5. Measure depth of embedment and record on slate.
6. Use hammer by lifting it to handle and let it free fall to drive head (one hammer blow).
7. Count number of hammer blows to embed cone shaft utill next groove is even with seafloor; record on slate.
8. Count number of hammer blows to embed cone shaft 3 inches (to next groove); record on slate.
9. Continue as in 8, above, until cone shaft is embedded to 30-inch depth or until 50 hammer blows fails to produce a 3-inch penetration; record hammer blows on slate.
10. Use hammer upward to remove cone shaft from seafloor.
11. Clean, lubricate, and store tool properly after use (see manual).

V. DATA OBTAINED:

1. Hammer blow counts per 3-inch interval of seafloor penetration up to 30 inches; hammer blows should be counted starting with "one" for each 3-inch interval.

Figure 5.16. Summary instruction sheet for MSPT.



Tool	Part No.	
5	1	Cone shaft
	2	Cone
	3	Drive head
	4	Hammer
	5	Hammer guide tube
	6	Handle
	7	O-ring

MSPT
(Minature Standard Penetration Test)

Table 5.1. Troubleshooting - MSPT

Problem	Probable Cause	Corrective Action
No or little penetration after 50 hammer blows	1. May have hit a rock or cobble	1. Remove tool from seafloor, move over about 1 ft, and try test again
	2. May have a bedrock surface, cemented soil layer, or other impenetratable layer	2. Stop test; record depth at which this "refusal" is met
Cone shaft falling out of guide shaft	1. Cone shaft not pushed in tight enough to hold	1. Push cone shaft in harder
	2. O-ring seal may need to be replaced	2. Check O-ring and replace if necessary
	3. Top of slot may have deformed until cone shaft no longer fits	3. Guide shaft will have to be replaced
Hammer blows do not seem right for type of soil in comparison with past experience	1. Hammer weight not correct	1. Check hammer weight
	2. Drop height not correct	2. Check operation procedure
	3. Hammer may be hanging up on something has deformed	3. Check to see if guide shaft is bent or if something on hammer or shaft

Figure 5.17. Cleaning threads.

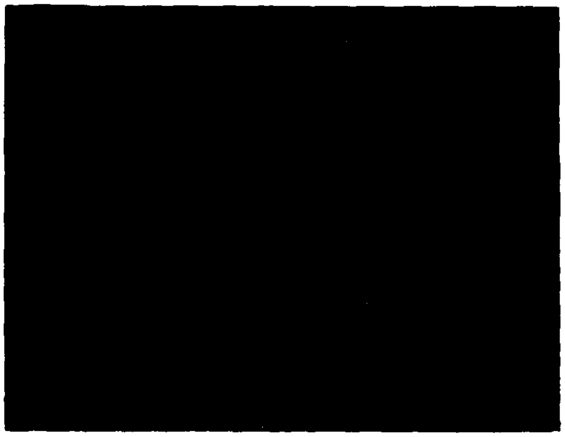


Figure 5.18. Wiping down tool with rust preventative.

consists of a parts list (Table 5.2) and an illustration (Figure 5.19). The parts in the list are indexed to the illustration, and the indexing reflects the disassembly sequence.

5.7.2 Parts List

The parts list (Table 5.2) includes all major components, assemblies, and detail parts for the MSPT. Each illustrated part shown disassembled in Figure 5.19 is assigned an index number. Parts shown as assemblies are listed (whenever possible) with reference to the figure number that shows the part disassembled.

5.7.2.1 Figure and Index Number Column. The figure and index number column list is in numerical order. The figure and index number of each part is shown on the corresponding illustration.

5.7.2.2 Reference Designation Column. The reference designation column will remain blank because there are no designated electrical or electronic parts for the MSPT.

5.7.2.3 Part Number Column. The part number column lists the manufacturer or Government part number for all parts shown in the applicable drawings. An entry of COML designates that the part or material is generally available through a variety of commercial sources or vendors. This column may also contain a NO NUMBER entry, indicating that the part has no applicable part number but is identified for procurement by the data in the description column.

5.7.2.4 Indent Column. The numbers 1 through 3 in the indent column show the relationship of parts and subassemblies to assemblies and/or installations. For any given figure, a number 1 indent item is the top level of an assembly or installation, and a number 3 indent is the lowest level of disassembly.

5.7.2.5 Description Column. The description column contains descriptions of all parts listed in the applicable drawings. Modifiers are included to identify the characteristics of a particular item. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference. A cross-reference appears both in the listing where the assembly is first described and in the listing in which the assembly is broken down. In the latter, the abbreviation REF appears in the quantity per assembly column. Abbreviations in the description column are generally in accordance with MIL-STD-12C and/or as noted in the list of abbreviations and acronyms.

Table 5.2. Parts List - MSPT

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
5.19-0		82-4-1F	1	MSPT (MINIATURE STANDARD PENETRATION TEST) (FOR NHA SEE FIG 5.19)	80091	REF	
5.19-1		82-4-1F-4	2	SHAFT, QQ-S-763 (AL 6061-T6)	80091	1	
5.19-2		82-4-1F-5	2	CONE, QQ-S-763 (316 SS)	80091	1	
5.19-3		82-4-1F-3	2	HEAD, DRIVE, QQ-A-200/8 (AL 6061-T6)	80091	1	
5.19-4		82-4-1F-6	2	HAMMER, QQ-S-763 (316 SS)	80091	1	
5.19-5		82-4-1F-2	2	TUBE, HAMMER GUIDE, QQ-A-200/8 (AL 6061-T6)	80091	1	
5.19-6		82-4-1F-1	2	HANDLE, QQ-A-200/8 (AL 6061-T6)	80091	1	
5.19-7		82-4-1F-7	2	O-RING (MIL-25372)	80091	1	

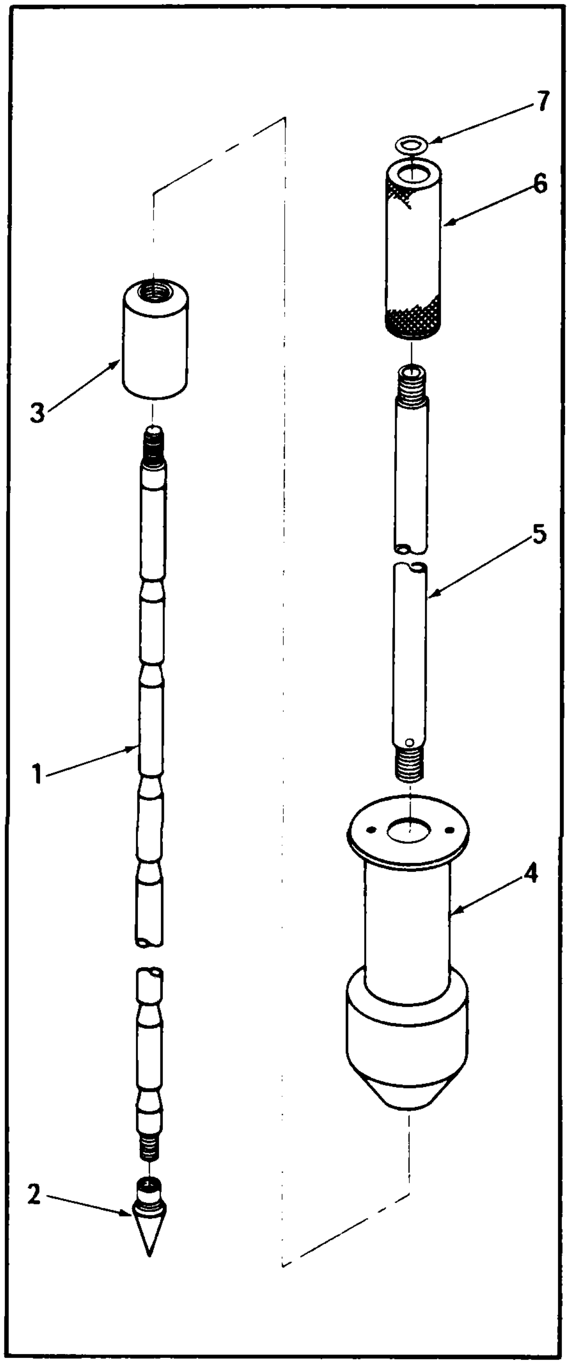


Figure 5.19. MSPT (miniature standard penetration test).

5.7.2.6 Manufacturer's Code Column. The manufacturer's code column lists numbers identifying the suppliers of the parts. Table 5.3 lists both suppliers and codes, which are also available in the Federal Supply Code for Manufacturers, Cataloging Handbooks H4-1 and H4-2.

5.7.2.7 Quantity Per Assembly Column. The quantity per assembly column contains one of the following entries: a numeral indicating the quantity of the item used only at the indicated location or the abbreviation REF, indicating that the required quantity is listed on the figure referenced in the description column.

5.7.2.8 Used-On Code Column. This column will remain 'lank because there are no used-on codes applicable to this parts list.

5.7.3 Abbreviations and Acronyms

The abbreviations and acronyms listed in Table 5.4 appear in the parts list and in the text of this manual. Abbreviations used in the text may be in lower case letters, initial capitals with lower case letters, or all capitals. Abbreviations used in the parts list are in all capitals. The abbreviations and acronyms listed in Table 5.4 are in all capitals for consistency.

5.8 TOOL KIT

5.8.1 Introduction

This section explains the function of the MSPT tool kit and presents a list of the kit contents and the purpose of each item. Procurement information is given in Section 5.11. An Illustrated Parts Breakdown for the MSPT tool is given in Section 5.7.

5.8.2 Tool Kit Function

The MSPT tool kit is designed to be self-sufficient in the field with the exception of freshwater for washing down the tool after use. The kit contains all the spare and repair parts necessary to maintain the MSPT tool in the field (Figure 5.20). The MSPT tool kit is packaged with the vane shear tool kit in the

Table 5.3. List of Manufacturers' Codes, Names, and Addresses

Code	Name and Address
02697	Parker-Hannifin Corporation Seal Group, O-Ring Division 2360 Palumo Drive Lexington, KY 40509
30781	Parker-Hannifin Corporation Packing Division 2220 S. 3600 W. Salt Lake City, UT 84119
31995	Jenkins Bros. 101 Merritt 7 Norwalk, CT 06851
35708	Textron Canada LTD Homelite-Terry Division 180 Labrosse Avenue P.O. Box 1800 Pointe Claire, Que Can H9R 4R6
39428	McMaster-Carr Supply Company P.O. Box 4355 Chicago, IL 60680
75336	Kingston F.C. Company 1007 N. Main Street Los Angeles, CA 90012
80091	Naval Facilities Engineering Command Washington, DC 20370
80094	Smith Herman H., Inc. 1913 Atlantic Avenue Manasquan, NJ 08736
81646	Ideal Corporation Sub of Parker-Hannifin Corporation 1000 Pennsylvania Avenue Brooklyn, NY 11207
95760	Protective Closures Company, Inc. 2150 Elmwood Avenue Buffalo, NY 14207
98773	Soiltest, Inc. 2205 W. Lee Street Evanston, IL 60202

Table 5.4. List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AP	Attaching Part
ASSY	Assembly
ASTM	American Society for Testing and Materials
COML	Commercial
CONN	Connector
CRES	Corrosion Resistant Steel
DEG	Degree
DIA	Diameter
EXT	Extension
FEM	Female
FIG	Figure
FT	Feet
GA	Gage
GAPL	Group Assembly Parts List
ID	Inside Diameter
IN.	Inch/Inches
INSTL	Installation
IPB	Illustrated Parts Breakdown
L	Long
MSPT	Miniature Standard Penetration Test
NHA	Next Higher Assembly
NPT	National Taper Pipe (Thread)
OD	Outside Diameter
PT	Point
PVC	Polyvinyl Chloride
REF	Referenced
SQ	Square
SS	Stainless Steel
ST	Street
STD	Standard
SUBASSY	Subassembly
THD	Thread

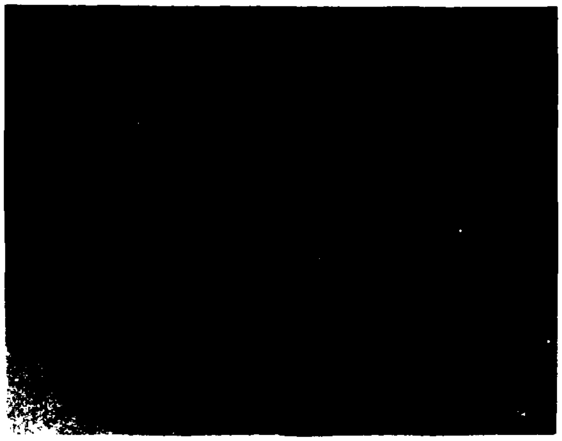


Figure 5.20. MSPT kit contents.

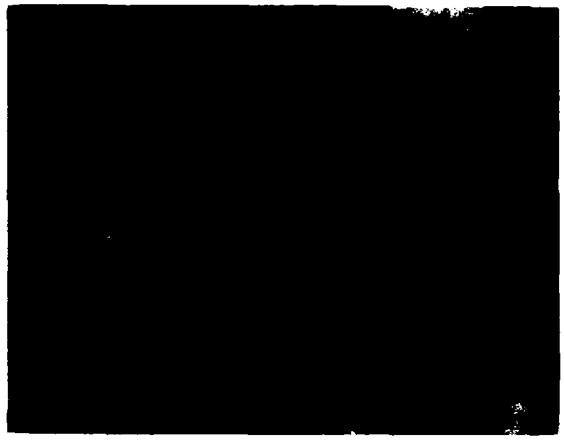


Figure 5.22. Top MSPT kit.

same box. Some of the support items are shared by the two kits. The box containing the kits is 4 feet long, 2 feet wide, and 1.4 tall, and weighs 146 pounds fully equipped.

5.8.3 MSPT Tool Kit Contents

A list of the tool kit contents is shown in Table 5.5. The kit contents are listed as they are placed in the box, from bottom (Figure 5.21) to top (Figure 5.22) and from back to front. A brief explanation of the function of each item in the kit is given in Table 5.6.

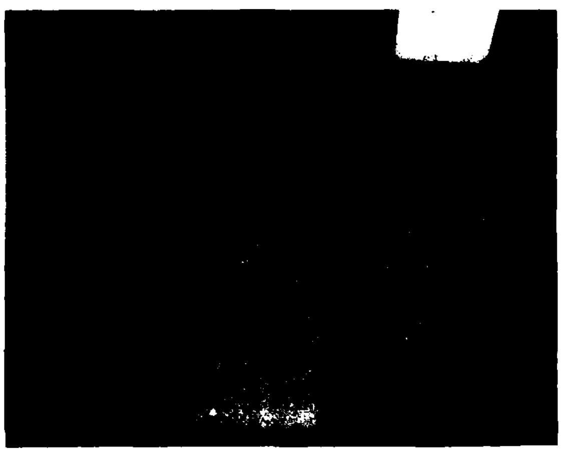


Figure 5.21. Bottom MSPT kit.

5.9 SHIPPING AND STORAGE

5.9.1 Introduction

The MSPT tool is designed to be stored in the kit box. The contents of the kits were selected to allow the kit to be shipped by commercial and military truck, ship, and aircraft. Shipping regulations change over time, so current regulations should be checked before shipment.

5.9.2 Storage

Contents of the kit shall be prepared for storage by ensuring that all metal parts have been cleaned and are sprayed with a rust preventative, such as LPS-3.

5.9.3 Shipping

Current shipping regulations should be checked before shipping the MSPT tool kit. The only item in the kit that requires special care is the LPS-3. Special packaging and permits can be avoided by using LPS-3 in bulk form. It is the aerosol packaging of this substance that requires it to be shipped differently. By using bulk LPS-3, the kit falls into the category of a combustible liquid. All that is required is marking the box "COMBUSTIBLE LIQUID."

Table 5.5. List of Contents - MSPT/Vane Shear Kit

Item	No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier	Manufacturer/Supplier Part Number
1	1	Kit box	4.31/5.27	--	83-26-1F		Local carpenter shop	
2	1	LPS-3 (1 gal bulk)					Local supplier	
3	1	Spray bottle - LPS-3						FSN 8125-00-488-7952
4	1	Spray bottle - water						FSN 8125-00-488-7952
5	1	Never-Seize						FSN 8030-00-180-6187
6	1	Silicone grease						FSN 6850-00-880-7616
7	1	Plastic bucket (4 qt)						FSN 7240-00-061-1163
8	2	Terry towel (pkg)						FSN 7920-00-823-9772
9	1	MSPT-diver data slate	5.28				Local shop	
10	1	Vane shear-diver data slate	4.32				Local shop	
11	100	MSPT data sheets	B-7(5.13)				Local print shop	
12	100	Vane shear data sheets	B-6(4.18)					
13	5	Planning sheets	B-1					
14	5	Summary sheets	B-2					
15	5	Site data sheets	B-3					
16	5	Site sketch sheets	B-4					
17	5	Tool fail. & inadeq. report	B-10					
18	1	Bench vise, clamp base						FSN 5120-00-243-1372
19	2	Brass weight, 1 kg					Local scientific supply	
20	12	Pencils, #1						FSN 7510-00-286-5757
21	2	Erasers						FSN 7510-00-323-8788
22	10	O-rings	5.26	5.19-7	82-4-1F	7	Parker	
23	2	Cone shafts	5.26	5.19-1&2	82-4-1F	4,5	Local machinist	
24	1	Hammer guide tube	5.26	5.19-5,6,7	82-4-1F	1,2	Local machinist	
25	1	Hammer	5.26	5.19-4	82-4-1F	6	Local machinist	
26	1	Drive head	5.26	5.19-3	82-4-1F	3	Local machinist	
27	2	Torque wrenches	4.30	4.25-5	82-2-1F	11	McMaster-Carr	5358A55
28	2	Sockets, 3/8 drive	4.30	4.25-4	82-2-1F	12	Local supply/electroplater	
29	2	Babbit hammers	4.30	4.25-7	82-2-1F	14	McMaster-Carr	4910A9
30	1	Wire brush-stainless steel						FSN 7920-00-269-1259
31	1	Vane (1 x 2 in.) and shaft	4.30	4.25-3	82-2-1F	1	Local machinist	
32	1	Vane (1.5 x 3 in.) and shaft	4.30	4.25-2	82-2-1F	2	Local machinist	
33	1	Vane (2.5 x 5 in.) and shaft	4.30	4.25-1	82-2-1F	3	Local machinist	
34	1	Vaneless shaft	4.30	4.25-8	82-2-1F	(1,2,3)	Local machinist	
35	1	Summary instruction sheet (MSPT)	5.16				Local printer	
36	1	Summ. instruc. sht (vane shear)	4.21				Local printer	
37	1	List of contents-MSPT/vane shear	Table 4.5 & 5.5				Local printer	

Table 5.6. Function of Kit Contents

Item	Description	Function in Kit
1	Kit box	Contain kit contents, shipping container
2	LPS-3 (bulk)	Rust preventative, lubricant for metal parts
3	Spray bottle - LPS-3	Apply bulk LPS-3
4	Spray bottle - water	Clean tool parts
5	Never-Seize	Lubricate threaded parts; prevent seizing and galling
6	Silicone grease	Lubricate O-ring; do not use other lubricants--they will deteriorate O-ring
7	Plastic bucket	Contain water for cleaning tools
8	Terry towels	Clean up tools, dry, and apply rust preventative
9	MSPT slate	Record MSPT data underwater--use #1 pencil; erase with pencil eraser
10	Vane shear slate	Record vane shear data underwater--use pencil only
11	MSPT data sheets	Permanent record of data--transfer data from slate to data sheet; reuse slate
12	Vane shear data sheet	Permanent record of data--transfer from slate to data sheet, erase, and reuse slate
13	Planning sheet	Plan geotechnical site survey (see Chapter 2)
14	Summary sheet	Summarize site survey (see Chapter 2)
15	Site data sheet	Record data location coordinates (see Chapter 2)
16	Site sketch sheet	Lay out site and mark and label data locations (see Chapter 2)
17	Tool fail. & inadeq. report	Report problems with tools and kits
18	Bench vise	Test torque wrenches for correct reading (see Section 4.3.2)
19	Brass weights, 1 kg	Test torque wrenches (see Section 4.3.2)
20	Pencils	Write on slates, data sheets
21	Erasers	Clean slates
22	O-ring	Lock cone shaft into MSPT handle
23	Cone shaft	Penetrate seafloor (see Section 5.2.4.2)
24	Hammer guide tube	Hammer drops along (see Section 5.2.4.4)
25	Hammer	Delivers exact amount of energy to cone shaft to cause penetration (see Section 5.2.4.1)
26	Drive head	Hammer falls on (see Section 5.2.4.3)
27	Torque wrench	Turns vane shaft; measures torque (see Section 4.2.4.4)
28	Socket	Quick connection between torque wrench and vane shaft (see Section 4.2.4.3)
29	Babbit hammer	Soft hammer to drive in cone shaft; does not deform end of shaft
30	Wire brush	Clean soil from tools
31	Vane - 1 x 2 in.	Determine vane shear strength (see Sections 4.2.4.1 & 2)
32	Vane - 1.5 x 3 in.	Determine vane shear strength (see Sections 4.2.4.1 & 2)
33	Vane - 2.5 x 5 in.	Determine vane shear strength (see Sections 4.2.4.1 & 2)
34	Vaneless shaft	Measure friction due to shaft only
35	Summary inst.-MSPT	Quick reference field guide
36	Summary inst.-vane shear	Quick reference field guide
37	List of contents-MSPT/vane shear	Guide to pack kit contents; replace contents

For shipping, the cube and weight of the packaging are given below:

MSPT/Vane Shear Kit	11.3 ft^3	146 lb

5.10 DATA ANALYSIS

5.10.1 Introduction

The data taken with the MSPT are in-situ data. MSPT data are more meaningful in cohesionless soils than in cohesive soils. This discussion of the MSPT data analysis is directed at cohesionless soils, specifically sands. The data from the MSPT currently provide a qualitative rather than quantitative measurement of soil density.

MSPT data are taken in the form of hammer blow counts symbolized by N. These hammer blow counts represent the soil's resistance to penetration by the cone and cone shaft. These hammer blows can eventually be related to soil properties by compiling a history of use--hammer blow counts and laboratory data on the same soil. At the present time, this compilation of data has just started. Time and future use of the tool will allow more accurate estimation of soil properties. With a reliable estimate of the in-situ density of the sand, an estimate of the sand's strength as a friction angle can be made.

5.10.2 Data Analysis

An analysis of the data taken with the MSPT can provide information on the density and uniformity of the soil. To analyze the data, the first step is to take a critical look at the data. The next step is to evaluate the data and then relate it to other soil properties. Guidelines for doing this are given below.

1. Look at the numbers recorded as hammer blow counts on the data sheets. Compare sets of data taken in nearby areas. The blow counts should have been counted for each 3-inch interval along the cone shaft. If the numbers seem to get very large very quickly, perhaps they were counted continuously during the whole 30-inch penetration. This can be corrected by subtracting them to get the blows for each 3-inch interval. Check with the divers to find out what they did. Perhaps the soil is very dense.

2. Look at the depth the cone sunk initially under the weight of the tool. The cone should be embedded a least a distance of 3 inches before the effect of the free soil surface does not influence the data. If the tool did not sink much under its own weight, ignore the data taken in the first 3-inch interval. Also ignore any blow counts that are not for a full 3-inch interval, such as those required to get the next interval groove even with the seafloor after the initial sinking of the cone tip.

3. Compare the number of hammer blows over the depth of penetration. If they are very close or increase slightly with depth, the soil is uniform with depth.

4. Compare the number of hammer blows at each interval from different sets of data taken in the area to check for uniformity across the area.

5. Data compiled for two different sands is presented in Figures 5.23 and 5.24. These data can be used as a guide to analysis of MSPT data. These figures should be used cautiously. If the grain size analysis of your sample is close to that of the sands tested (Figure 5.23), then the relative density graph (Figure 5.24) can be used as an estimate of soil properties. The relative density can be related to the friction angle of a sand using Figure 5.25. If your sand is not close in grain size to those in Figure 5.23, the data in Figure 5.24 do not apply. The best thing to do is to take impact cores along with the MSPT data and determine grain size, in-place density, and friction angle from direct shear and establish a correlation that can be referred to for future analysis. Send any such data to Code L42, Naval Civil Engineering Laboratory, Port Hueneme, CA 93043, so that such a correlation can be established.

5.11 PROCUREMENT INFORMATION

5.11. Introduction

All the necessary information to procure the MSPT diver tool, the MSPT/vane shear

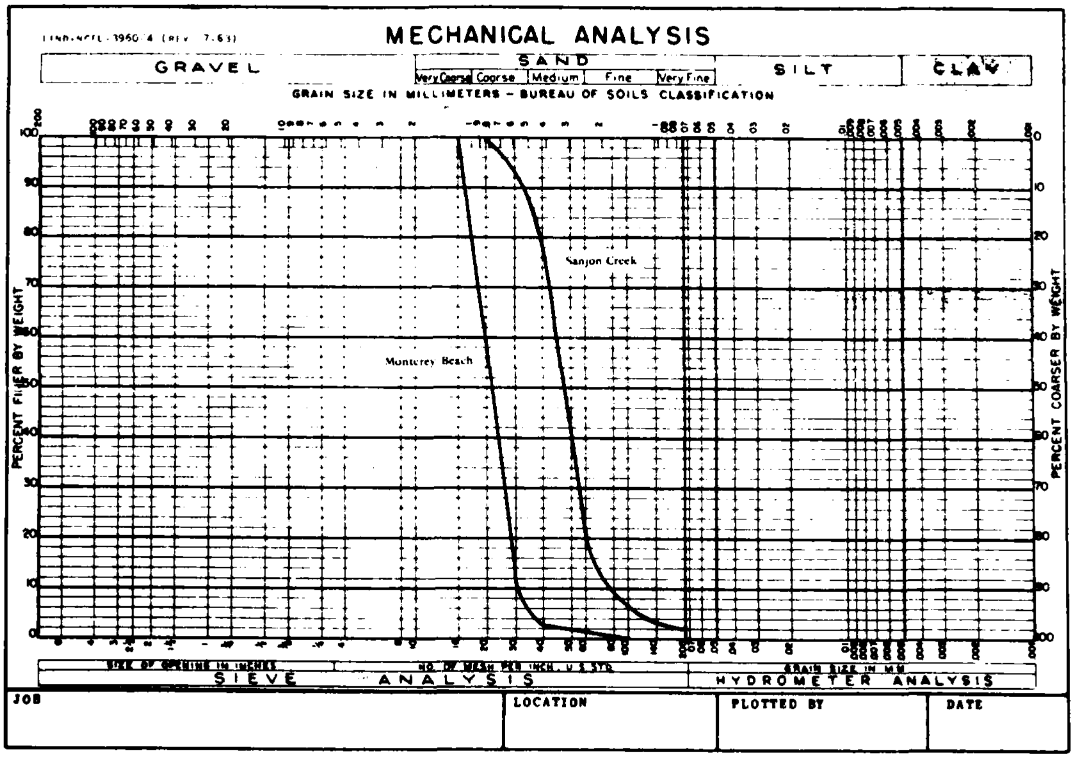


Figure 5.23. Sieve analsysis of bagged, dried, No. 1C Monterey Beach sand and sand from Sanjon Creek, Ventura, CA.

kit, and all the kit's contents is contained within this manual. The information can be found in the following locations:

Table 5.5	List of Contents MSPT/ Vane Shear Kit
Section 5.7	Illustrated Parts Breakdown - MSPT
Section 5.11.2	Purchase Description
Section 5.11.3	Manufacturers/Suppliers
Section 5.11.4	Drawings
Appendix B	Data Sheets

Table 5.5 can be used as a master list to procure anything in the kit. Within the table is information such as drawings, manual figure numbers, part numbers, and manufacturers.

5.11.2 Purchase Description

1. SCOPE. This purchase description establishes the requirements for the manufacture and acceptance of the geotechnical diver tools. These tools consist of a miniature standard penetration test (MSPT) device, vane shear, impact corer, vacuum corer, jet probe, and rock classifier.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense

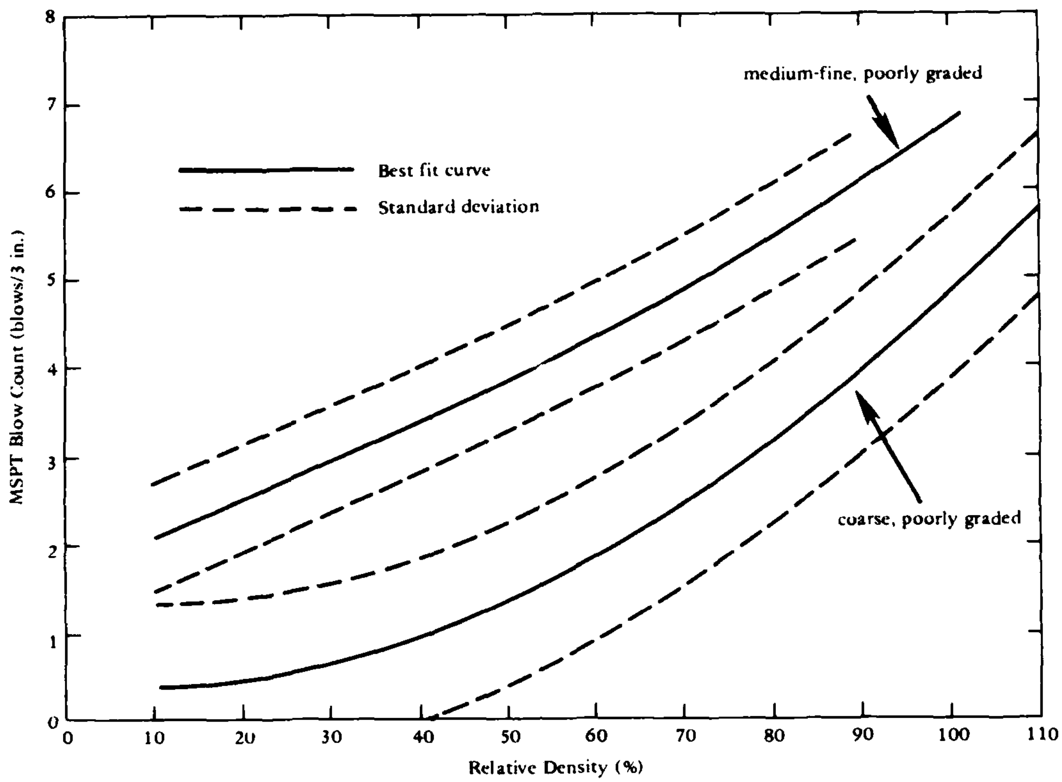


Figure 5.24. Curves fitted to correlation data using cubic spline (standard deviations shown by dotted lines).

Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this purchase description to the extent specified herein.

DRAWINGS

Figure No.	NCEL Drawing No.	Title
5.26	82-4-1F	Miniature Standard Penetration Test (MSPT)
5.27	83-26-1F	Kit Box for MSPT and Vane Shear
5.28	--	Diver Slate - MSPT

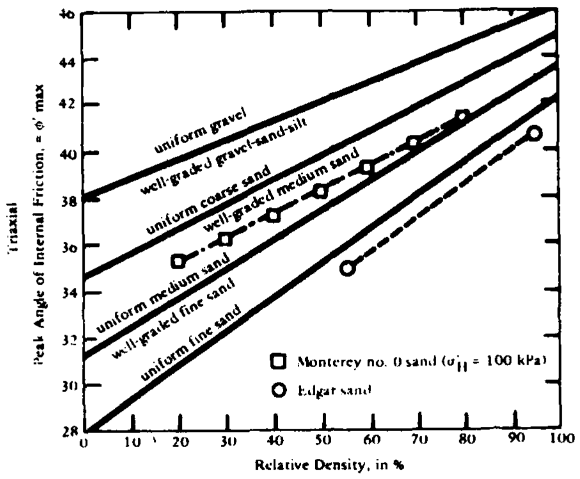


Figure 5.25. Triaxial cell friction angles for various sands as a function of relative density. (Schmertmann, 1978)

(Copies of drawings required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this purchase description and the references cited herein, the text of this purchase description shall take precedence.

3. REQUIREMENTS

3.1 Drawings. The drawings referenced in 2.1.2 are level 2 end- product drawings. No deviation from the prescribed dimensions or tolerances is permissible without prior approval of the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation. Any data (such as shop drawings, layouts, flow sheets, and processing procedures) that are prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 Dimensions. All tool dimensions shall conform to the requirements specified in the end product drawings referenced in 2.1.2.

3.3 Materials. Materials shall be as specified herein and in other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this purchase description. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Materials shall conform to the requirements specified in the end product drawings listed in 2.1.2.

3.4 Workmanship. All parts, components, and assemblies of the geotechnical tools, including machined surfaces, seals, and welded parts, shall be clean and free from any defects in workmanship. External surfaces shall be free from burrs, slag, sharp edges, and corners except where sharp edges or corners are required.

3.5 Interchangeability. All parts referenced in the drawings in 2.1.2 that are described by the same part number shall be physically and functionally interchangeable.

3.6 Assembly. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.7 Threaded connections and fasteners. No threaded connections or fasteners shall show evidence of cross threading or mutilation.

3.8 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the weld. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.9 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.10 Weights. Where indicated in drawings, weights of parts and subassemblies must be maintained within tolerances stated.

3.11 Seals. Where indicated in drawings, seals shall be installed with the necessary care required to maintain the watertight integrity of the tool.

3.12 Finish. All finishes shall conform to specifications shown in the drawings listed in 2.1.2 and shall be free from nicks, burrs, and surface defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The contractor is responsible for ensuring that components and materials used are manufactured, examined, and tested in accordance with the referenced sections of this purchase description. Each part, subassembly, and assembly shall be inspected according to the inspection requirements specified in Table I.

4.3 Inspection procedure.

4.3.1 Dimensional verification. All components shall be checked for conformance with the dimensions and tolerances specified in the drawings referenced in 2.1.2. Measurement shall be conducted using instruments capable of measurements of ± 0.001 inch.

4.3.2 Visual inspection. Visual inspection shall be performed for compliance with material and workmanship requirements specified in the drawings referenced in 2.1.2.

4.3.3 Mechanical assembly. Component assembly shall be conducted to verify form, fit, and function of individual manufactured components.

4.3.4 Weighing. Components that have weights specified in the drawings referenced in 2.1.2 shall be checked using a standard certified scale capable of ± 0.1 percent accuracy.

4.4 Inspection failure. Failure of production geotechnical tools to meet any requirement specified herein during and as a result of the specified inspection shall be cause for rejection of the production tools and shall be cause for refusal by the Government to continue acceptance of production tools until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

5. PREPARATION FOR SHIPMENT

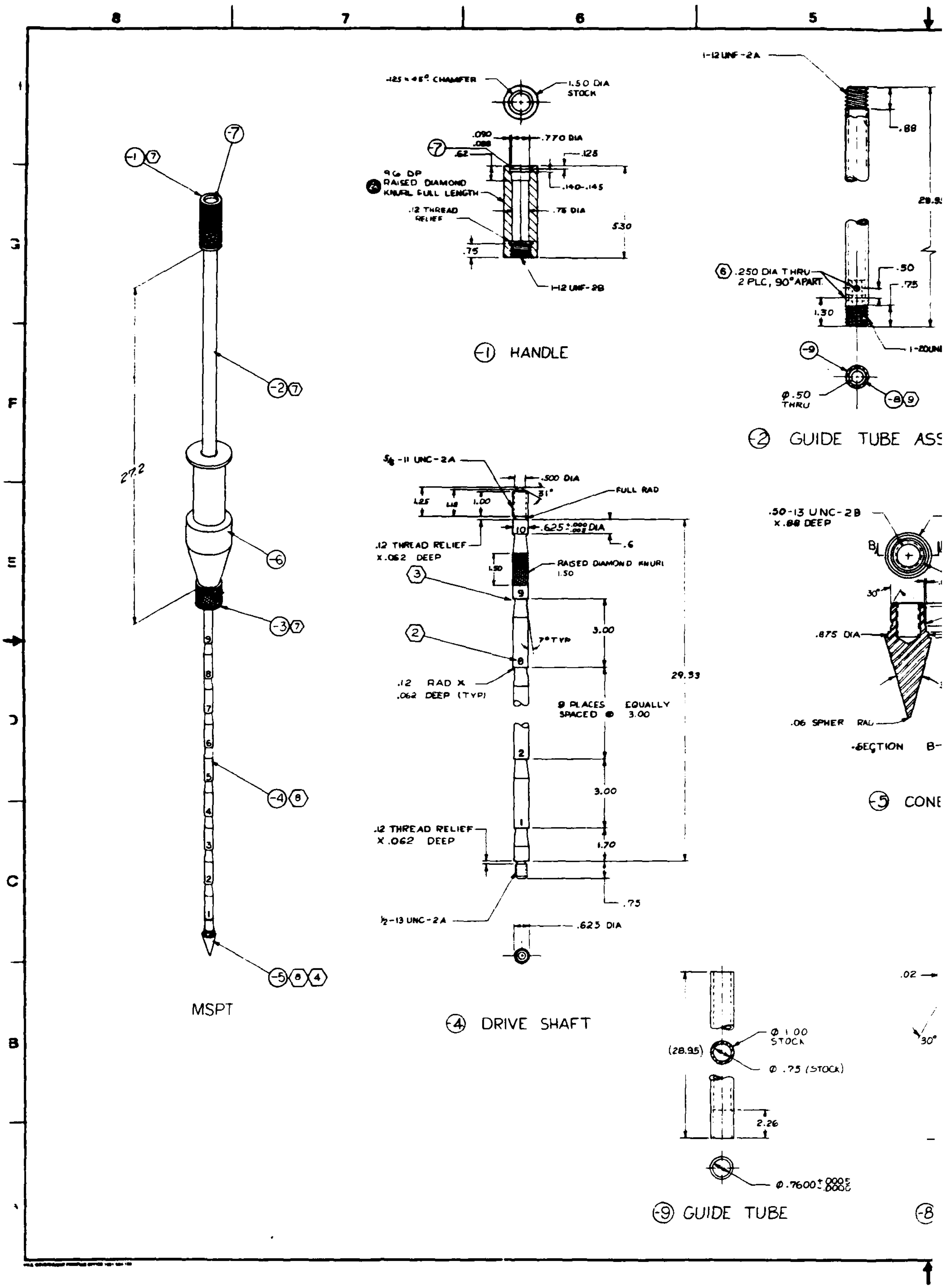
5.1 Preservation and packaging. All parts and subassemblies shall be preserved and packaged in accordance with MIL-STD-1188.

5.11.3 Manufacturers/Suppliers. Space is left for you to write in local suppliers.

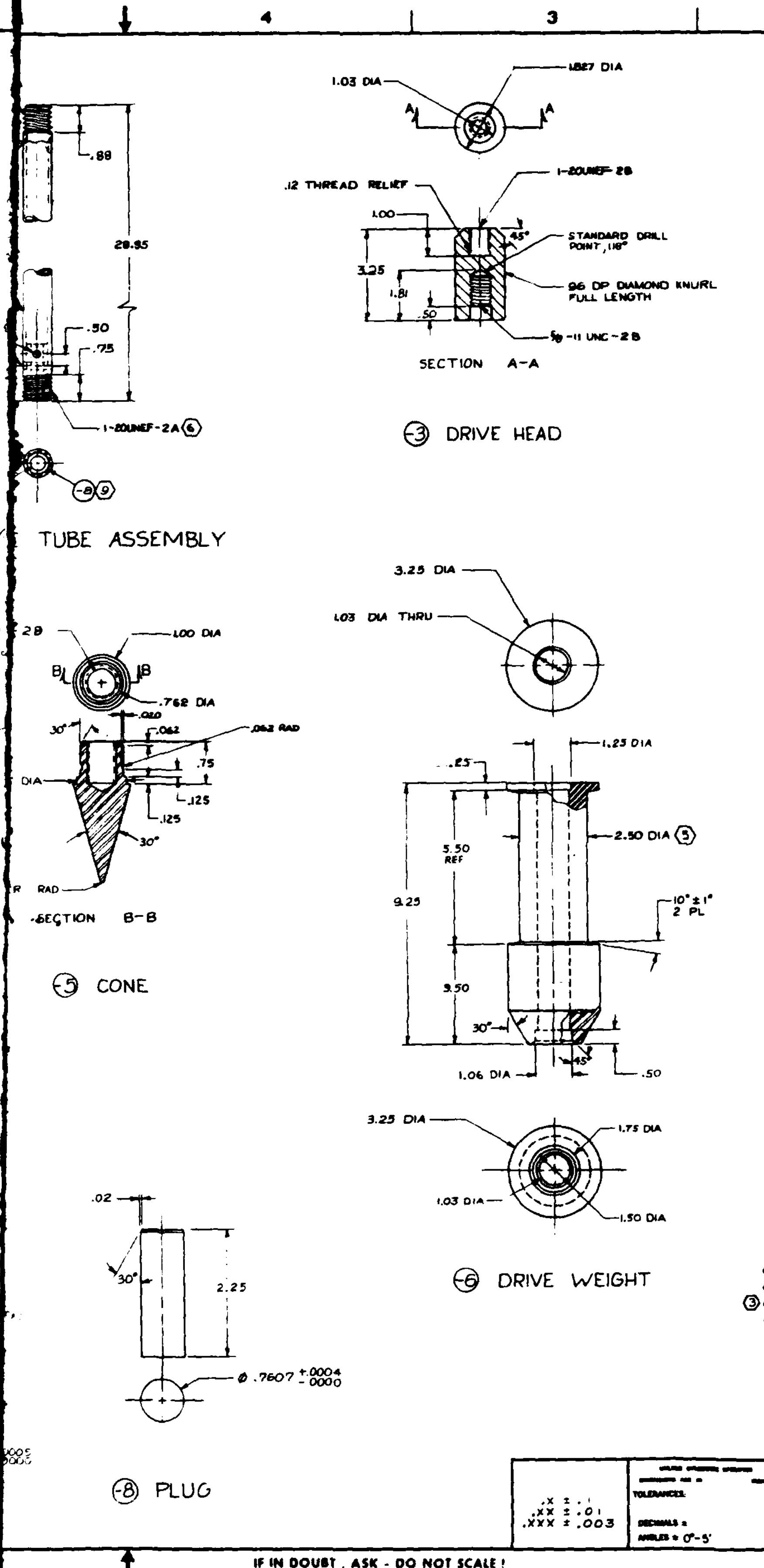
5.11.4 Drawings

The following drawings are included in this section:

Figure No.	NCEL Drawing No.	Title
5.26	82-4-1F	Miniature Standard Penetration Test (MSPT)
5.27	83-26-1F	Kit Box For MSPT and Vane Shear
5.28	--	Diver Slate - MSPT



8
7
6
5
MSPT
27.2
-1 HANDLE
.125 x 45° CHAMFER
1.50 DIA STOCK
.770 DIA
.125
.140-.145
96 DP RAISED DIAMOND KNURL FULL LENGTH
.12 THREAD RELIEF
.75 DIA
5.30
.75
1-12 UNF-2B
-4 DRIVE SHAFT
5/8-11 UNC-2A
.500 DIA
FULL RAD
1.25
1.00
.12 THREAD RELIEF X .062 DEEP
RAISED DIAMOND KNURL 1.50
3.00
7° TYP
29.33
.12 RAD X .062 DEEP (TYP)
9 PLACES EQUALLY SPACED @ 3.00
1.70
.75
1/2-13 UNC-2A
.625 DIA
1-12 UNF-2A
.88
.250 DIA THRU 2 PLC, 90° APART
.50
.75
1.30
φ.50 THRU
-2 GUIDE TUBE ASS
.50-13 UNC-2B X .88 DEEP
.875 DIA
.06 SPHER RAD
SECTION B-
-5 CONE
φ 1.00 STOCK
(28.95)
φ .75 (STOCK)
2.26
φ .7600
-9 GUIDE TUBE



1	REVISED	10/3/83	
2	ADDED KNURLING NOTE		

NOTES:

1. REMOVE ALL SHARP EDGES AND BURRS.
2. STAMP 1/4 INCH HIGH CHARACTERS ON DRIVE SHAFT. STAMP EACH CHARACTER AS SHOWN AND ON OPPOSITE SIDE. PAINT EACH CHARACTER WITH FLORESCENT YELLOW COLOR TO ACCENTUATE CONTRAST.
3. PAINT EACH GROOVE WITH FLORESCENT YELLOW COLOR TO ACCENTUATE CONTRAST.
4. USE SEMIPERMANENT THREAD LOCKING SEALANT TO INSTALL -5 CONE ONTO -4 DRIVE SHAFT.
5. REMOVE MATERIAL FROM 2.50 ∅ TO OBTAIN A FINAL WEIGHT OF 5261 ± 45 GRAMS (11.6 ± .1 LBS) FOR DRIVE WEIGHT. (1 IN. DEPTH - 50 GRAMS)
6. CUT THREADS (USING DIE) AND DRILL HOLES AFTER PRESSING PLUG (PART-8) INTO GUIDE TUBE (PART-9).
7. TOTAL WEIGHT OF HANDLE, GUIDE TUBE AND DRIVE HEAD = 1000 ± 20 GRAMS. EXCESS MASS MAY BE REMOVED FROM THIS AREA (MINIMUM DIA = 1.37 IN.). ADDITIONAL WEIGHT MAY BE ADDED BY USING LEAD PELLETS AND EPOXY IN BOTTOM OF GUIDE TUBE AFTER ASSEMBLY (DO NOT OBSTRUCT RELIEF HOLES)
8. TOTAL WEIGHT OF DRIVE SHAFT AND CONE = 1300 ± 26 GRAMS.
9. PRESS PLUG (PART-8) INTO THE END OF GUIDE TUBE (PART-9) THAT IS MACHINED TO ∅ .7600 ID.

PARTS LIST

NOTE	PART NO.	QUAN	DESCRIPTION		MATERIAL
	-9	1	GUIDE TUBE	QQ-A-200/8	AL 6061-T6
	-8	1	PLUG	QQ-S-763	CRES 316
	-7	1	O RING		MIL-25372
	-6	1	DRIVE WEIGHT	QQ-S-763	CRES 316
5	-5	1	CONE	QQ-S-763	CRES 316
4	-4	1	DRIVE SHAFT	QQ-S-763	CRES 316
3 2	-3	1	DRIVE HEAD	QQ-A-200/8	AL 6061-T6
6	-2	1	GUIDE TUBE ASSEMBLY		
	-1	1	HANDLE	QQ-A-200/8	AL 6061-T6

TOLERANCES: .X ± .1, .XX ± .01, .XXX ± .003; DECIMALS ±; ANGLES ± 0°-5'

PROJ NO YF60.536.091.01.A104
NCEL DWG NO 82-4-1F 2
L42 RHOADS
K. MaeA 5-27-82

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

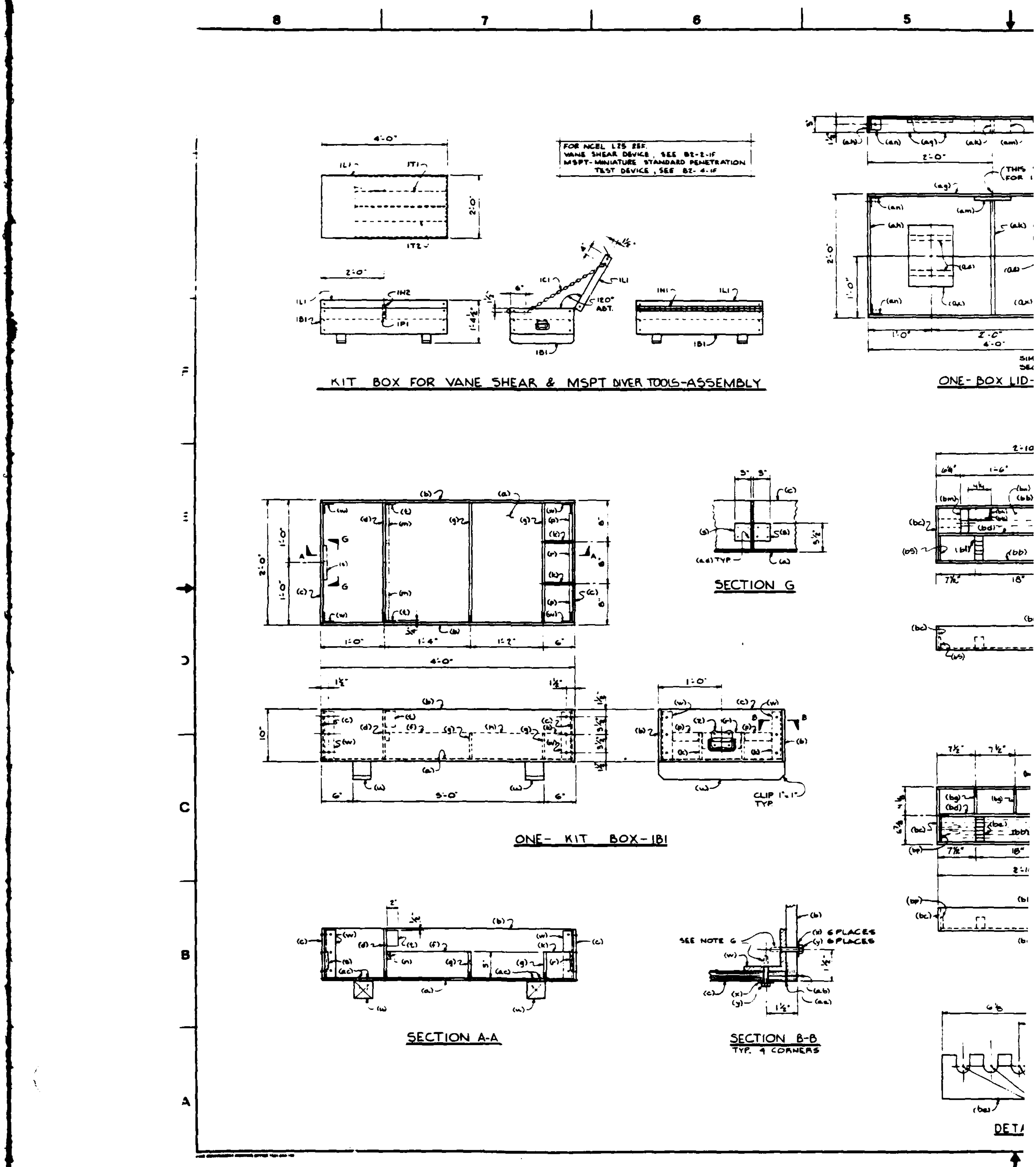
GEOTECHNICAL DIVER TOOL DEVELOPMENT
MINIATURE STANDARD PENETRATION TEST (MSPT)

SIZE F CODE IDENT NO 80091
SCALE NONE SHEET 1 OF 1

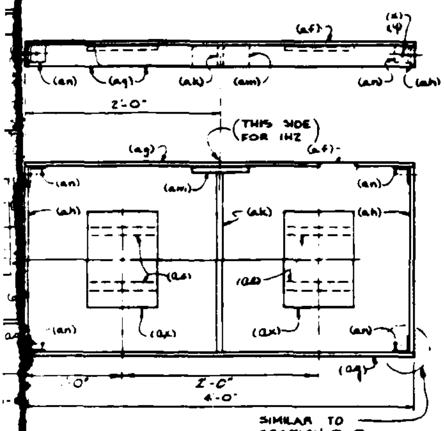
J81-29 (L42) (REV 2)

82-4-1F

Figure 5.26. Miniature standard penetration test (MSPT).



8
7
6
5
FOR NCEL L25 REF.
VANE SHEAR DEVICE, SEE B2-2-1F
MSPT-MINIATURE STANDARD PENETRATION
TEST DEVICE, SEE B2-4-1F
KIT BOX FOR VANE SHEAR & MSPT DIVER TOOLS-ASSEMBLY
120° ABT.
ONE-BOX LID-
SECTION G
ONE- KIT BOX-1B1
CLIP 1"x1" TYP
SECTION A-A
SEE NOTE 6
6 PLACES
6 PLACES
SECTION B-B
TYP. 4 CORNERS
F
E
D
C
B
A

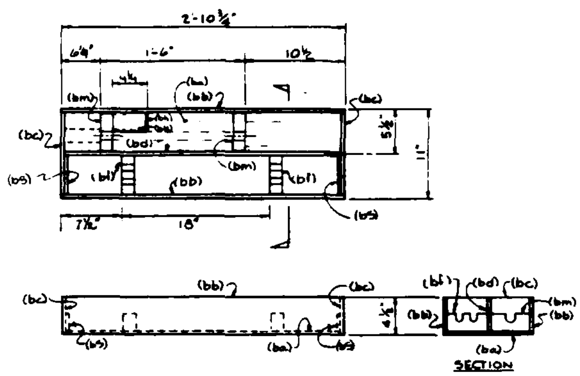


ONE-BOX LID-1L1

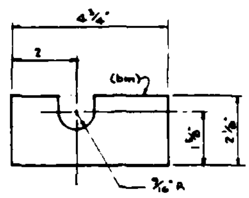
NOTES:

1. ALL PLYWOOD SHALL BE STRUCTURAL I, C-C EXTERIOR.
2. ALL LUMBER SHALL BE STANDARD DRESSED CONTRUCTION GRADE, DOUGLAS FIR.
3. ALL PROTRUDING WOOD SCREWS SHALL BE GROUND FLUSH.
4. ALL WOOD JOINTS SHALL BE GLUED & NAILED. SPACE NAILS @ 2" ON CENTERS FOR 2d & 4d NAILS, 2½" FOR 8d.
5. APPLY PLASTIC WOOD COMPOUND TO ALL PLYWOOD EDGES. PRIME & COAT ALL WOOD SURFACES & EDGES WITH EXTERIOR PAINT; FINISH COLOR TO BE GRAY.
6. ALL PROTRUDING SELF DRILLING SCREWS SHALL BE CUT & GROUND FLUSH TO ALUM. ANGLES; COUNTER PUNCH THREADS TO LOCK.
7. ALL ROUGH EDGES & CORNERS ON WOOD & ALUMINUM SHALL BE SANDED & GROUND SMOOTH, RESPECTIVELY.
8. AVAILABLE: McMASTER - CARR SUPPLY CO LOS ANGELES, CA 90054

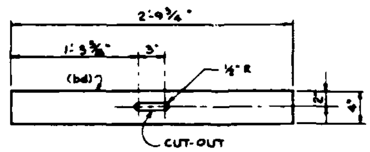
	4	NO. 6	0	0½	ROUND HEAD SLOTTED SCREWS STAINLESS STEEL 18-8
	2	NO. 35	2	10½	STAINLESS STEEL SASH CHAIN
2-BOX LID CHAINS-1C1 (NOT DETAILED)					
	ONE	1⅝"W × 1⅜"H			NO. 1557A54, NOTE 8
ONE-PADLOCK-1P1 (NOT DETAILED)					
	A/R	NO. 7 × ⅝"L. ON 1B1 NO. 7 × 1⅛"L ON 1L1			WOOD SCREWS FLAT HEAD SLOTTED BRASS
	ONE	1½" × .130"THK.	0	4	CAST BRASS WITH STAPLE PLATE AND SCREWS. NO. 1848A15 NOTE 8
ONE-SAFETY HASP-1H2 (NOT DETAILED)					



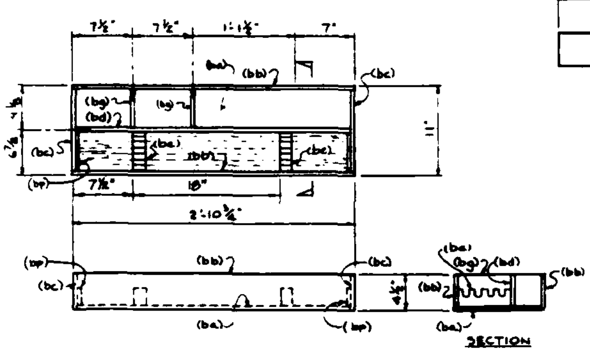
ONE-TRAY "A"-1T1



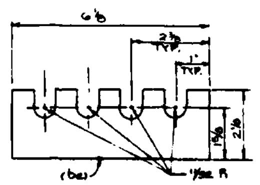
DETAIL F



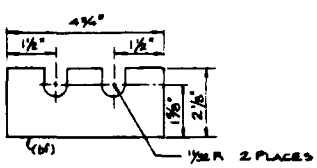
DETAIL E



ONE-TRAY "B"-1T2



DETAIL C



DETAIL D

REVISIONS			

MARK	NO REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS
	A/R	NO. 6	0	0½	FLAT HEAD SLOTTED, S.S. 18-8
	ONE	2" × .060"THK	4	0	STAINLESS STEEL TYPE 3022B
ONE-CONTINUOUS HINGE-1H1 (NOT DETAILED)					
bs	2	⅛ × 2⅛	0	4¾	HARDWOOD SPACER
ad	A/R	2d NAILS			SEE 1B1 REMARKS
ab	A/R	4d NAILS			
aa	A/R	GLUE			SEE 1B1 REMARKS
bp	2	⅛ × 2⅛	0	6⅛	HARDWOOD SPACER
bm	2	1½ × 2½	0	4¾	LUMBER (FROM 2 × 4) DETAIL F
bk	1	¼ × 1½	0	4¼	PLYWOOD
bh	1	¼ × 1½	0	1 15/16	↓
bg	2	½ × 4	0	3⅞	PLYWOOD
bf	2	1½ × 2⅛	0	4⅝	LUMBER (FROM 2×4) DETAIL D
be	2	1½ × 2⅛	0	6⅛	LUMBER (FROM 2×4) DETAIL C
bd	2	½ × 4	2	9¾	PLYWOOD DETAIL E
bc	4	½ × 4½	0	10	↓
bb	4	½ × 4½	2	10¾	↓
ba	2	½ × 10	2	9⅞	PLYWOOD
ONE-TRAY "A"-1T1 & ONE-TRAY "B"-1T2					
ax	2	6½ × 12			CUPBOARD, NO. 898T12, NOTE 8
ad	A/R	2d NAILS			SEE 1B1 REMARKS
ab	A/R	4d NAILS			↓
aa	A/R	GLUE			↓
y	8	SCREWS			↓
x	8	WASHERS			SEE 1B1 REMARKS
an	4	L2 × 2 × ⅛	0	2	ALUM. 6061
am	ONE	1 × 2½	0	7	LUMBER
ak	ONE	1 × 2½	1	10½	LUMBER
ah	2	½ × 2½	1	11	PLYWOOD
ag	2	½ × 2½	4	0	"
af	ONE	½ × 24	4	0	PLYWOOD
ae	A/R	1" WIDE	2	10	VELCRO, HOOK AND LOOP FASTENING TAPE WITH ADHESIVE ATTACHMENT
ONE-BOX LID-1L1					
ad	A/R	2d NAILS			GALVANIZED STEEL
ac	A/R	8d NAILS			GALVANIZED STEEL
ab	A/R	4d NAILS			GALVANIZED STEEL
aa	A/R	GLUE			WATERPROOF RESORCINAL
z	2	5¾" × 4¼"			CAST BRASS CHEST HANDLE # 1848A6 NOTE 7, W/NO. 10 × 1⅜" S.S. 18-8 SCREWS NOTE 8
y	24	.216" ϕ	0	1¼	HEX WASHER HEAD ZINC PLATED STEEL SELF DRILLING SCREWS, # 94222A306 NOTE 8
x	24	¼"I.D. × ½"O.D. × .05"THK			FLAT WASHERS, STAINLESS STEEL 18-8
w	4	L2 × 2 × ⅛	0	9	ALUM. 6061
u	2	4 × 4	2	0	LUMBER
t	2	¼ × 2	0	3	PLYWOOD
s	ONE	1 × 4	0	6	LUMBER
r	ONE	1 × 4	0	7½	↓
p	2	1 × 2	0	5¼	↓
m	ONE	1 × 2	1	11	LUMBER
k	2	½ × 5	0	5¼	PLYWOOD
					↓
g	2	½ × 5	1	11	
d	ONE	½ × 9½	1	11	
c	2	½ × 10	1	11	
b	2	½ × 10	4	0	↓
a	ONE	½ × 23	3	11	PLYWOOD
ONE- KIT BOX-1B1					
MARK	NO REQ'D	SIZE	FT	IN	REMARKS

BILL OF MATERIAL

PROJ NO Y1606-01-001-A601

NCEL DWG NO 83-26-1F

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND

NAVAL CIVIL ENGINEERING LABORATORY

PORT HUENEME, CALIFORNIA

GEOTECHNICAL TOOL SYSTEM

KIT BOX FCF

VANE SHEAR & MSPT DIVER TOOLS

SIZE F CODE IDENT NO 80091

SCALE NONE

TOLERANCES: FRACTIONS ± ⅛, DECIMALS ±, ANGLES ±

IF IN DOUBT, ASK - DO NOT SCALE

J83-15 (L42)

Figure 5.27. Kit box for vane shear and MSPT devices.

USE SOFT LEAD PENCIL ONLY

MSPT

Site & Data ID					
Hammer Serial#					
DEPTH		HAMMER BLOW COUNT			
mark	inches				
1	3				
2	6				
3	9				
4	12				
5	15				
6	18				
7	21				
8	24				
9	27				
10	30				

NOTES:

Figure 5.28. MSPT diver's slate. Engrave layout onto a 9x12x1/8-inch piece of white, high-impact styrene plastic, leaving a 1-inch border all around. Paint with black paint, wipe off while wet, leaving black paint in grooves. Drill hole at top center of slate to attach line for pencil and for attaching slate to diver.

CHAPTER 6

ROCK CLASSIFIER

6.1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

6.1.1 General Information

The rock classifier is a hand-operated diver tool that takes in-situ data on surface rock. The rock classifier is a tool designed for rock testing on land based on the design of the Schmidt hammer, which was originally used for nondestructive testing of concrete. An underwater housing and a new plunger have been designed to adapt it for underwater use. The plunger of the hammer is pressed against the surface to be measured. The Schmidt hammer design uses an internal hammer that rebounds off the plunger to measure surface hardness. A photograph of the rock classifier in its underwater housing is shown in Figure 6.1. The major components of the tool are identified in the photograph. The tool is 19 inches long and weighs 7 pounds in air and 3 pounds in seawater. It takes about 10 minutes to take one set of data at one spot with the rock classifier.

The rock classifier is packaged as a kit with spare and repair parts and support equipment in a box. This kit contains one rock classifier in an underwater housing and one spare rock classifier. The number of data points that can be obtained is limited only by the condition of the equipment. The box is 4 feet long, 2 feet wide, and 1.4 feet tall, and it weighs 147 pounds when fully equipped.

The geotechnical data obtained with the rock classifier are a rebound number, R, read off a scale on the hammer. Ten good data readings must be taken at one spot on the rock and then averaged for the final number. This final number can be converted to rock compressive strength and tangent modulus through tables, which are presented in the data analysis section.

6.1.2 Safety Precautions

The rock classifier is a hand-operated tool that presents no safety hazards to the diver. However, to prevent damage to the tool, it must be well-maintained in order for it to function properly.

6.2 FUNCTIONAL DESCRIPTION

6.2.1 Introduction

This section provides a functional description of the rock classifier and the theory of operation of the tool.

6.2.2 Tool Function

The tool's function is to take in-situ surface rock data that can be converted to an estimate of the rock's compressive strength. This is an estimated value that is quicker and easier to obtain than taking rock cores and subjecting the cores to compression testing.

6.2.3 Functional Sequence

The rock classifier is taken to the seafloor by the divers along with the rock pick and chisel. The divers locate a rock surface that appears flat and unbroken. Using the chisel and rock pick, they chip off a spot on a flat surface. A rock chip is obtained for later visual identification of rock type. Holding the rock classifier vertically, one diver pushes the plunger down against the rock slowly. When the internal

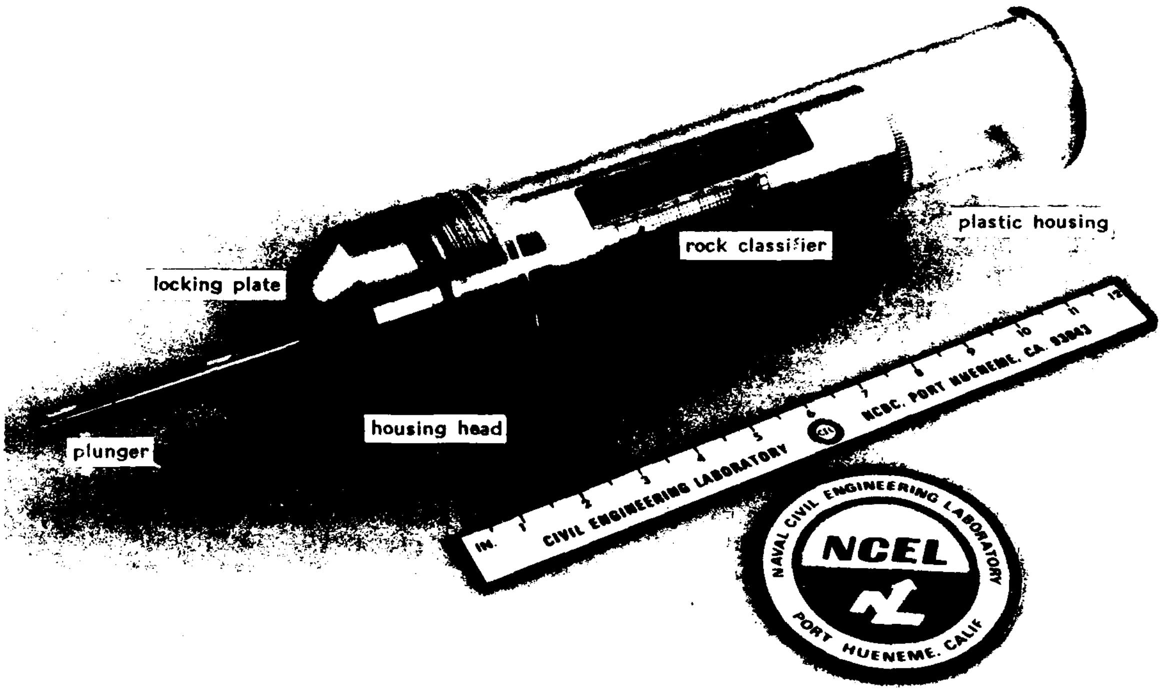


Figure 6.1. Rock classifier.

hammer rebounds, a number is read off the scale on the side of the hammer. This number is recorded and the sequence repeated until a total of 10 good data numbers has been taken in one spot which will be averaged for the final data point.

6.2.4 Component Function and Theory of Operation

6.2.4.1 Rock Classification Hammer. The rock classification hammer takes data as a rebound number symbolized by R that can be converted to rock compressive strength and tangent modulus. The design of the rock classification hammer is based on that of the Schmidt hammer developed for non-destructive compressive strength testing of concrete. The first tests on rock were done with the N-type hammer designed for concrete. This N-type hammer has an impact energy of 1.63 ft-lb, which crushed the rock it was testing. An L-type hammer was designed with an impact energy of 0.54 ft-lb for rock and lightweight concrete. The rock classifier diver tool uses an L-type rock classification hammer in an underwater housing.

The L-type rock classification hammer is about 10 inches long and 2 inches in diameter. A drawing showing the internal parts of the hammer is in Figure 6.2. The hammer is held vertically upright with the plunger down against the rock to be tested. When the plunger is depressed, it moves an internal hammer mass upward inside the hammer a set distance. This mass is attached to a spring. When the hammer mass is moved the full set

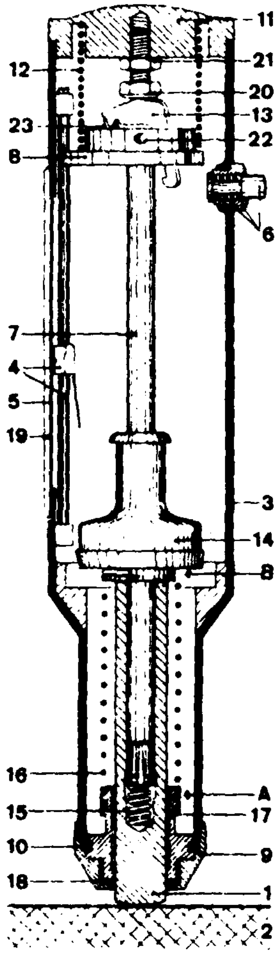


Figure 6.2. Longitudinal section of the rock classifier (Type L Schmidt test hammer).

distance, it is released. The hammer mass is accelerated back down toward the inside end of the plunger. The hammer mass impacts and then rebounds off the end of the plunger. The amount of rebound of the hammer mass (an internal distance) is shown by the scale on the outside of the hammer. This rebound number, R, is directly related by the impact energy to the hardness of the material the plunger was depressed against. The measured R can be related to rock properties through charts presented in Section 6.10.

6.2.4.2 Plunger. The plunger in the rock classifier diver tool is not the same plunger that comes with the "off-the-shelf" rock classification hammer. This is a modified plunger to adapt the hammer to the underwater housing. The modified plunger has the same mass as the original plunger, so no calibration factor is needed to make use of the historical rock data already collected and used for analysis. The modified plunger has been coated with a special metal alloy to resist seawater corrosion.

6.2.4.3 Underwater Housing. The underwater housing allows the rock classification hammer to be used underwater with only minor modifications to the hammer. Seals have been placed between the housing and the plunger to allow plunger movement and prevent leaking. The locking plate on the underwater housing provides a means of retaining the hardness reading on the scale without having to push in the button on the original hammer, which would be unreachable inside the housing.

6.3 ASSEMBLY, OPERATION, AND DATA RECORDING

6.3.1 Introduction

This section explains step-by-step the assembly, operation, and data recording for the rock classifier tool. If the tool has been properly maintained, it is simple and easy to use. It take about 10 minutes to take a set of data with the rock classifier.

6.3.2 Assembly

The rock classifier in the underwater housing is fully assembled when removed from its box. It is assumed that the BEFORE-USE MAINTENANCE STEPS have already been done. The following steps should be done before the tool is taken into the water.

ASSEMBLY STEPS:

1. Unscrew the plastic housing from the retaining head far enough to expose the O-ring. Lubricate the O-ring with silicone grease (Figure 6.3) and screw back together. Use strap wrenches to loosen the head from the housing if needed (Figure 6.4).

Figure 6.3. Lubricating O-ring seal with silicone grease.

2. Clean the tip of the plunger. It should be free of dirt or the tool will not function correctly.

3. Check the calibration of the rock classifier on the calibration anvil following the steps below (Figure 6.5):

(a) Clean the tip of the plunger and surface of the calibration anvil.

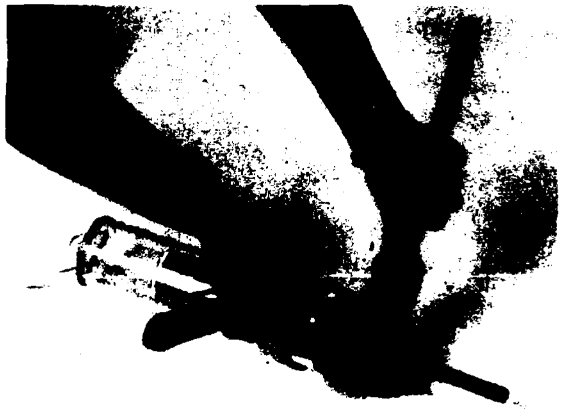


Figure 6.4. Using strap wrenches to loosen housing.

Figure 6.5. Testing rock classifier on calibration anvil.

(b) Find the calibration number, N_c, on the anvil. This number is for the concrete test hammer. Subtract 17 to get the correct calibration number, N_r, for the rock classifier. This number is N. Record this number on the data sheet (see example).

(c) Keeping the tool vertical, take 10 readings on the anvil. (See Section 6.3.3 for operation of the tool.) The 10 readings should all be in the range of ± 3 of the majority of the readings. Record these readings on a data sheet and note the column as calibration (see example).

(d) Add the 10 readings together and then divide the total by 10. This is the average R calibrate, or R_{cal} (see example).

(e) The average R should fall in the range of the calibration number, $N_r \pm 2$ (see example). If not, the tool can be adjusted following the steps in Section 6.6.2.2. If the average R is close to the 64 ± 2, the data taken with the classifier can be adjusted using the calibration results and the equation in Section 6.10.

4. Tie a thin line to the padeye on the underwater housing if there is none on it.

5. Assemble the rock classifier, data slate, rock pick, and chisel for divers to take down with them (Figure 6.6).

Figure 6.6. Diver's assembled equipment.

EXAMPLE - ROCK CLASSIFIER CALIBRATION

Step (b) example:

Calibration anvil says:

N_c = <u>READ 80</u> N_c = <u>READ 78</u>

$N_r = 80 - 17$ $N_r = 78 - 17$
$N_r = 63$ $N_r = 61$

Step (c) example:

Readings taken on anvil:

R's		10 Good R's
61		61
17		59
59		64
64		62
62*	Since there are	60
32	more 62s than	62
60	any other number,	62
62*	$62 \pm 3 = 59$ to 65;	63
67	therefore, all	62
5	numbers between	65
66	59 and 65 are	
27	good readings.	
62*		
63		
62*		
65		

Step (d) example:

To find the average of the 10 good readings:

61	
59	
64	
62	
60	620/10 = 62
62	
62	Average $R_{cal} = 62$
63	
62	
+65	
620	

Step (e) example:

Acceptable range = $N_r \pm 2$, which is $63 \pm 2 = 61$ to 65

Average $R_{cal} = 62$

Since 62 is in the range of 61 to 65, this rock classifier is OK.

6.3.3 Operation

The operation of the rock classifier is described in the following steps:

OPERATION STEPS:

1. Diver take to the seafloor the rock classifier, data slate, pencil, rock pick, chisel, protractor, and plastic bags.

2. Find a rock surface in the test area that has a horizontal surface.

3. Use chisel and rock pick to chip off a rock sample to bring up and to chip off a smooth, clean, flat (horizontal) surface on which to perform the rock classification test (Figure 6.7). This test spot should be as flat as possible. Any pieces of rock chipped off should be saved in one of the plastic bags. Keep rock samples from each site separate.

Figure 6.7. Chipping off rock surface.

Small rock samples from each data location are necessary to analyze the data. Make a note on the data slate about how hard the rock is to chip with the rock pick.

4. Hold the rock classifier vertical with the plunger down. Check to see if the rock classifier is 90 degrees from the rock surface with the protractor. The plunger should be fully extended (Figure 6.8). If it is not, see step 7.

Figure 6.8. Placing rock classifier on prepared rock surface.

5. Press the plunger slowly against the surface to be tested, keeping the tool vertical until the internal hammer rebounds (Figure 6.9).

6. When the plunger has been fully depressed and the internal hammer has rebounded, the plunger will be held in the depressed position by the locking plate so that the scale marker is held at the R measured. Read this R number and record it on the slate (use only lead pencil) (Figure 6.10).

7. To extend the plunger again, depress it against the rock or other hard surface and press the locking plate against the housing. Slowly let the plunger back out. It is very important to do this slowly and to start with the plunger pressed against a hard surface to prevent the plunger from shooting out. If the

Figure 6.9. Depressing plunger.

Figure 6.10. Reading rebound number off scale.

plunger shoots out, it may cause the housing to leak. The hammer will not measure rock hardness correctly if this happens.

8. The test should be repeated until 10 good R numbers are obtained at one rock location. Any R numbers that are three points higher or lower than the majority should be repeated. Keep an eye on the rock surface tested. If it shows signs of crushing or wear, move over slightly and continue.

6.3.4 Data Recording

The data taken with the rock classifier are recorded on the diver's slate and then later transferred to data sheets. Use only a soft lead pencil on the slate, and clean with a pencil eraser. Clean the slate with cleanser soap and water. The diver's slate is shown in Figure 6.11 and the data sheet in Figure 6.12. From the example site survey in Chapter 2, rock classifier data were taken at site B. The slate would look as shown in Figure 6.13 at the end of the test and the completed data sheet is shown in Figure 6.14. These data are a rebound number, R, representing the rock's hardness. These data are used to determine the rock's compressive strength and tangent modulus as explained in Section 6.10.

6.3.5 Summary Instruction Sheet

The above instructions for the assembly and operation of the rock classifier have been condensed to one page with an illustrated parts breakdown on the back side (Figure 6.15). A copy of the page can be laminated and kept in the kit box for quick field reference. These instructions are very brief, intended to function as a reminder, so the manual should be read first.

6.4 SCHEDULED MAINTENANCE

6.4.1 Introduction

Maintenance on the rock classifier is very important for the proper functioning of the tool. Due to the sensitive nature of the tool, it is recommended that all maintenance be done before the tool is taken into the field. If the rock classifier must be taken out of the housing and taken apart for adjustment or repair, this should be done by the OCEI. Maintenance on the rock classifier should be performed after use, during storage, and before use.

6.4.2 After-Use Maintenance

Field after-use maintenance for the rock classifier is minimal. The steps are listed below:

FIELD AFTER-USE STEPS:

1. Rinse the housing and plunger with freshwater and then dry off with a terry towel.

2. Open the housing and look for signs of water inside. Use the strap wrenches if the housing is hard to unscrew (Figure 6.4). If no water is present, screw the housing back together and place it in its box.

3. If water is present in the housing, make a note of it on the data sheet and then try to dry up the water with terry towels. Do not replace the plastic housing. Wrap the rock classifier in terry towels and place it in the kit box to be cleaned up by the OCEI. If more testing needs to be done, remove the tool from the head and place the spare rock classifier in the housing.

4. Clean and dry all items before placing in the kit box.

6.4.3 Before-Storage Maintenance (OCEI)

After the rock classifier has been used in the field and before it is stored, the tool should be removed from the housing and completely taken apart. All the internal parts should be dried off and wiped down with a lint-free, lightly oiled cloth. This should be done by the OCEI.

6.4.4 During-Storage Maintenance (OCEI)

During storage, the rock classifier should be checked yearly for proper operation. This can be done by using the calibration anvil. A record of the calibration checks should be kept in the lid of the kit box (Figure 6.16). If the tool is not working properly, then

it should be taken apart and repaired as in Section 6.4.3. If the calibration is off, it should be adjusted as in Section 6.6.2.2.

6.4.5 Before-Use Maintenance (OCEI)

The rock classifier should be checked on the calibration anvil, and any necessary repairs, adjustments, or maintenance should be done before the tool is sent out for field use.

6.5 TROUBLESHOOTING

6.5.1 Introduction

This section presents some of the common problems that might occur in the operation of the rock classifier. The troubleshooting procedures are listed in Table 6.1. See Section 6.6 for corrective maintenance procedures.

6.6 CORRECTIVE MAINTENANCE

6.6.1 Introduction

This section describes specific corrective maintenance for field maintenance of the rock classifier.

6.6.2 Maintenance Procedures

6.6.2.1 Putting Hammer in Housing. Remove the plastic housing; unscrew the tool from the metal head and remove, pushing the plunger back through the head. Watch for the split rings that will fall out. Check the U-packing seal and O-ring and washer set for proper position as shown in Figure 6.17. Remove the red cap from the spare rock classifier, watching for the split rings that will fall out. Place the split rings back onto the tool and push the plunger through the head until the tool body will screw on. Be careful not to knock the retaining and bearing washers and O-ring out of position.

6.6.2.2 Adjusting for Calibration. Remove the plastic housing, extend the plunger, and unscrew the cap on the end of the rock classifier. If the calibration reading on the anvil was high, move the trip screw in the end cap (Figure 6.18) out in small increments and check the calibration. If the calibration reading was low, move the trip screw inward.

6.7 ILLUSTRATED PARTS BREAKDOWN

6.7.1 Introduction

This section contains the illustrated parts breakdown (IPB) for the rock classifier underwater housing. The IPB consists of a parts list (Table 6.2) and an illustration (Figure 6.19). The parts in the list are indexed to the illustration, and the indexing reflects the disassembly sequence. Soil tests parts list for the rock classifier is given in Figure 6.20.

6.7.2 Parts List

The parts list (Table 6.2) includes all major components, assemblies, and detail parts for the rock classifier underwater housing. Each illustrated part shown disassembled in Figure 6.19 is assigned an index number. Parts shown as assemblies are listed (whenever possible) with reference to the figure number that shows the part disassembled.

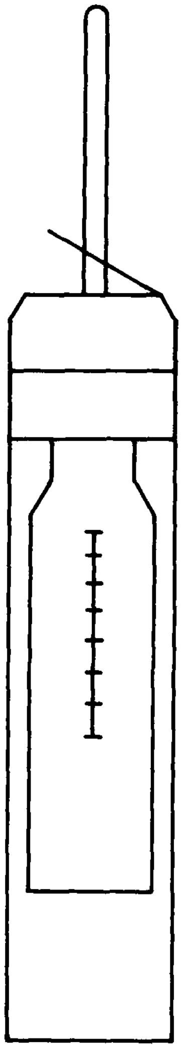
6.7.2.1 Figure and Index Number Column. The figure and index number column list is in numerical order. The figure and index number of each part is shown on the corresponding illustration.

6.7.2.2 Reference Designation Column. The reference designation column will remain blank because there are no designated electrical or electronic parts for the rock classifier.

6.7.2.3 Part Number Column. The part number column lists the manufacturer or Government part number for all parts shown in the applicable drawings. An entry of COML designates that the part or material is generally available through a variety of commercial sources or vendors. This column may also contain a NO NUMBER entry, indicating that the part has no applicable part number but is identified for procurement by the data in the description column.

USE SOFT LEAD PENCIL ONLY

ROCK CLASSIFIER



Site & Data ID				
Serial #				
REBOUND NUMBER, R				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

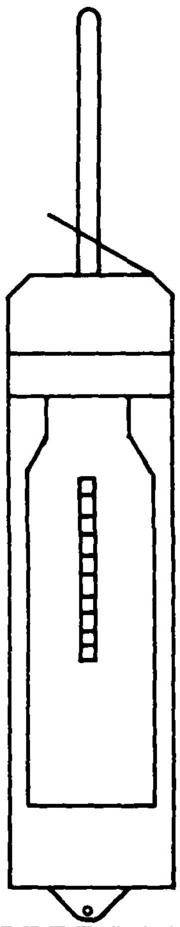
Figure 6.11. Rock classifier diver's slate.

ROCK CLASSIFIER DATA SHEET

Project: ______________________________

Date: ______________ Time: ______________

Divers: ______________________________



ROCK CLASSIFIER DATA FROM DIVER'S SLATE				
Data Location ID				
Serial No.				
Readings	REBOUND NUMBER, R			
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Observations: ______________________________

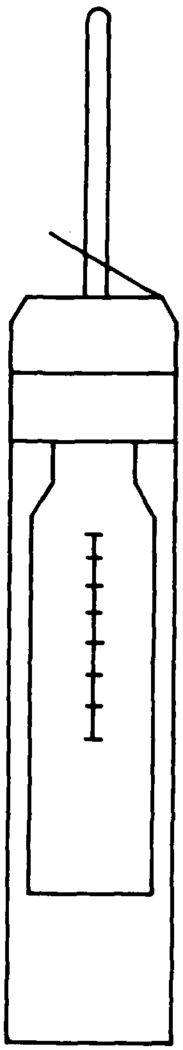
Problems: ______________________________

Rock Samples Collected:

Figure 6.12. Rock classifier data sheet.

USE SOFT LEAD PENCIL ONLY

ROCK CLASSIFIER



Site & Data ID	Calibrate	BA-23	BA-24	BB-27
Serial #				
REBOUND NUMBER, R				
1	60	33	30	40
2	62	30	28	41
3	66	38	30	35
4	65	36	31	39
5	61	35	33	38
6	63	30	32	36
7	65	36	33	41
8	66	37	34	42
9	61	35	30	37
10	62	35	32	38

NOTES:

Figure 6.13. Rock classifier diver slate with data from example in Chapter 2.

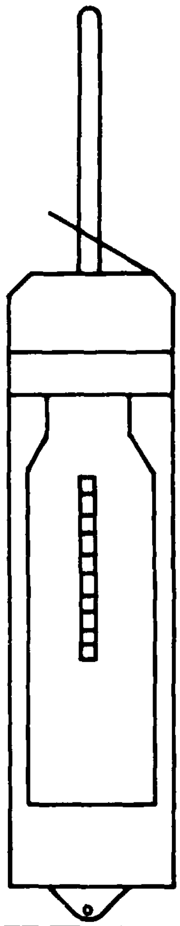
ROCK CLASSIFIER DATA SHEET

Project: Special Test Facility Project

Date: 14 JUN Time: 1000

Divers: Carpenter, Nichols

ROCK CLASSIFIER DATA FROM DIVER'S SLATE



Data Location ID	Calibrate	BH-23	BA-24	BB-27
Serial No.				
Readings	REBOUND NUMBER, R			
1	60	53	30	40
2	62	30	28	41
3	66	38	30	35
4	65	36	31	37
5	61	35	33	38
6	63	30	32	36
7	65	36	33	41
8	66	37	34	42
9	61	35	30	37
10	62	35	32	38

Observations:

Problems:

Rock Samples Collected:

Figure 6.14. Rock classifier data sheet with data from Chapter 2 example.

ROCK CLASSIFIER INSTRUCTION SHEET

(See Operation and Maintenance Manual for complete instructions.)

I. SAFETY PRECAUTIONS:

1. Check calibration of rock classifier before each use.
2. Do not release plunger from depressed position too fast, it will damage the tool.

II. ITEMS DIVERS NEED:

1. Rock classifier
2. Data slate and pencil
3. Rock pick
4. Chisel
5. Plastic sample bag
6. Protractor

III. TOOL ASSEMBLY:

1. Tool should be completely assembled as stored in kit box. If not, see manual.
2. Apply silicone grease to O-ring between plastic housing and head.

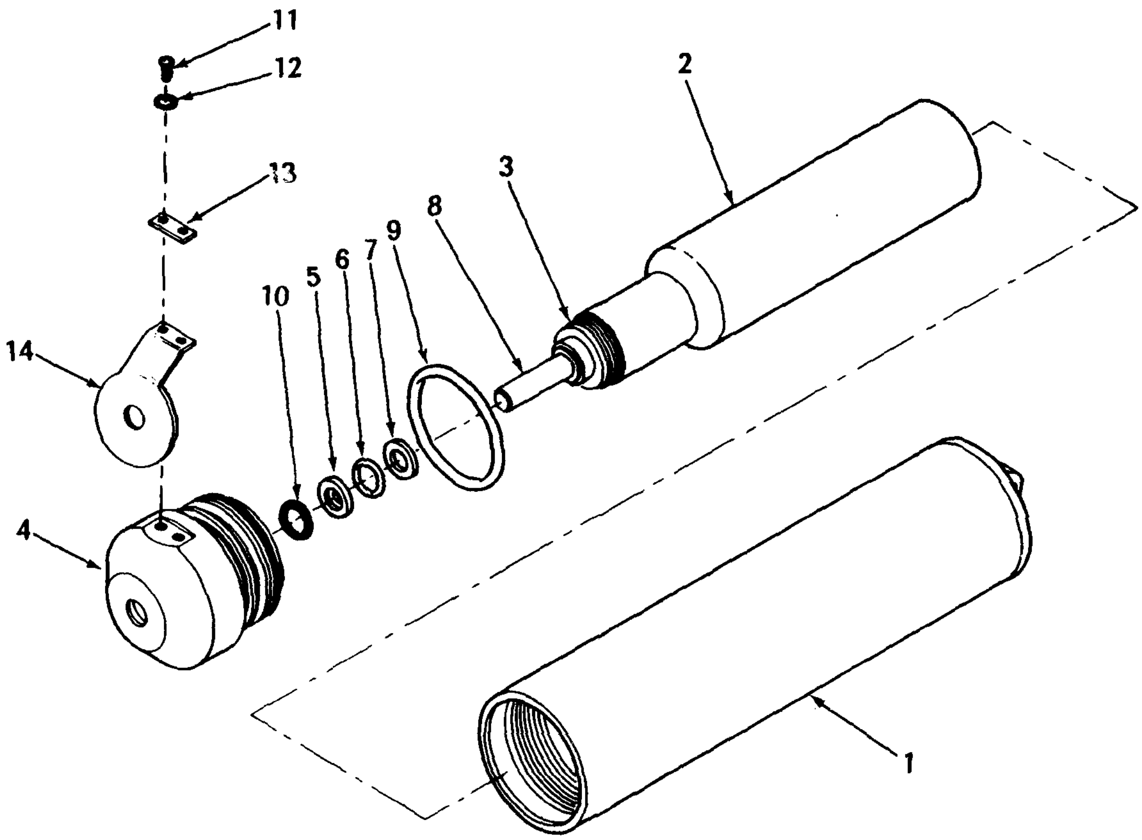
IV. TOOL OPERATION:

1. Use rock pick and chisel to create a flat, horizontal spot on rock surface. (Keep any chips in plastic sample bag for later visual identification.)
2. Hold rock classifier vertically against rock, plunger fully extended. Use protractor to check if 90 degrees from rock surface.
3. Depress rock classifier until internal hammer rebounds; locking plate should catch and hold plunger and rebound number on scale.
4. Read rebound number on scale and record on slate.
5. To extend plunger, depress plunger and push locking plate against head, then slowly let plunger out.
6. Repeat until 10 "good" rebound readings have been obtained at the spot.
7. Properly clean and store tool after use (see manual).

V. DATA OBTAINED:

1. Ten rebound numbers for each spot tested should fall within a range of $\pm$ 3 from the majority of the readings. If outside that range, the reading should be repeated. These 10 numbers will result in only one final data number for that spot.
2. Rebound numbers for the rock tested can be converted to compressive strength and tangent modulus (see manual).

Figure 6.15. Summary instruction sheet.



6	1	Plexiglass housing
	2	Rock classifier
	3	Two-part ring
	4	Head
	5	Bearing washer
	6	O-ring
	7	Retaining washer
	8	Plunger
	9	O-ring
	10	U-packing
	11	Machine screw
	12	Lock washer
	13	Washer plate
	14	Locking plate

CALIBRATION CHECKS ON ROCK CLASSIFIER

Date								
Ser No.								
R_{cal}								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Sum High 5								
Divide by 5								
R_{cal}								
Checked by								
Comments:								

Figu › 6.16. Calibration record for rock classifier.

Table 6.1. Troubleshooting - Rock Classifier

Problem	Probable Cause	Corrective Action
No R value indicated when tool is operated	1. Misfire of internal rebound hammer	1. Recock hammer and try again
	2. Internal tool parts malfunctioning	2. Put spare rock classifier in housing (see Section 6.6.2.1). Send tool to OCEI for repair (see Section 6.4.1)
Water in housing	1. Plastic housing not screwed on tightly	1. Check housing, clean out water, silicone grease O-ring, screw together tightly
	2. Large O-ring seal missing or not lubricated on housing	2. Look for O-ring, place in housing, and lubricate with silicone grease
	3. U-packing seal not in place	3. Take tool apart and check U-packing seal (see Section 6.6.2)
R values obtained vary widely	1. Tool malfunctioning, possibly water inside	1. Replace tool in housing with spare (see Section 6.6.2.1)
		2. Send tool to OCEI for repair (see Section 6.4.1)
R values on calibration anvil too high or too low	1. Tool needs adjustment	1. Take tool apart and adjust screw (see Section 6.6.2.2)
		2. Continue testing; record R on calibration anvil on data sheet for adjustment of data during analysis (see Section 6.10)

Table 6.2. Parts List - Rock Classifier

Figure & Index Number	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
6.19-0		81-2-1F	1	ROCK CLASSIFIER (FOR NHA SEE FIG ____)	80091	REF	
6.19-1		81-2-1F-3	2	CYLINDER (PLEXIGLAS)	80091	1	
6.19-2		TYPE "L"	2	HAMMER, SCHMIDT	98773	1	
6.19-3		81-2-1F	2	RING, TWO-PART	80091	1	
6.19-4		81-2-1F-1	2	HEAD, RING (QQ-S-763) (CRES 316)	80091	1	
6.19-5		81-2-1F-7	2	WASHER, BEARING, MIL-S-5059 (12 GA) (CRES 316)	80091	1	
6.19-6		2-015-N602-70	2	O-RING	02697	1	
6.19-7		82-7-2F-15	2	WASHER, RETAINING	80091	1	
6.19-8		81-2-1F-6	2	PLUNGER, IMPACT	80091	1	
6.19-9		2-231-N602-70	2	O-RING	02697	1	
6.19-10		8404-0050-4180	2	U-PACKING	30781	1	
6.19-11		MS51957-43	2	SCREW, MACHINE (CRES)	80091	2	
6.19-12		MS35338-137	2	LOCKWASHER (CRES)	80091	2	
6.19-13		81-2-1F	2	PLATE, WASHER, MIL-S-5059 (16 GA) (CRES 316)	80091	1	
6.19-14		81-2-1F-4	2	PLATE, LOCKING, MIL-S-5059 (20 GA) (CRES 316)	80091	1	

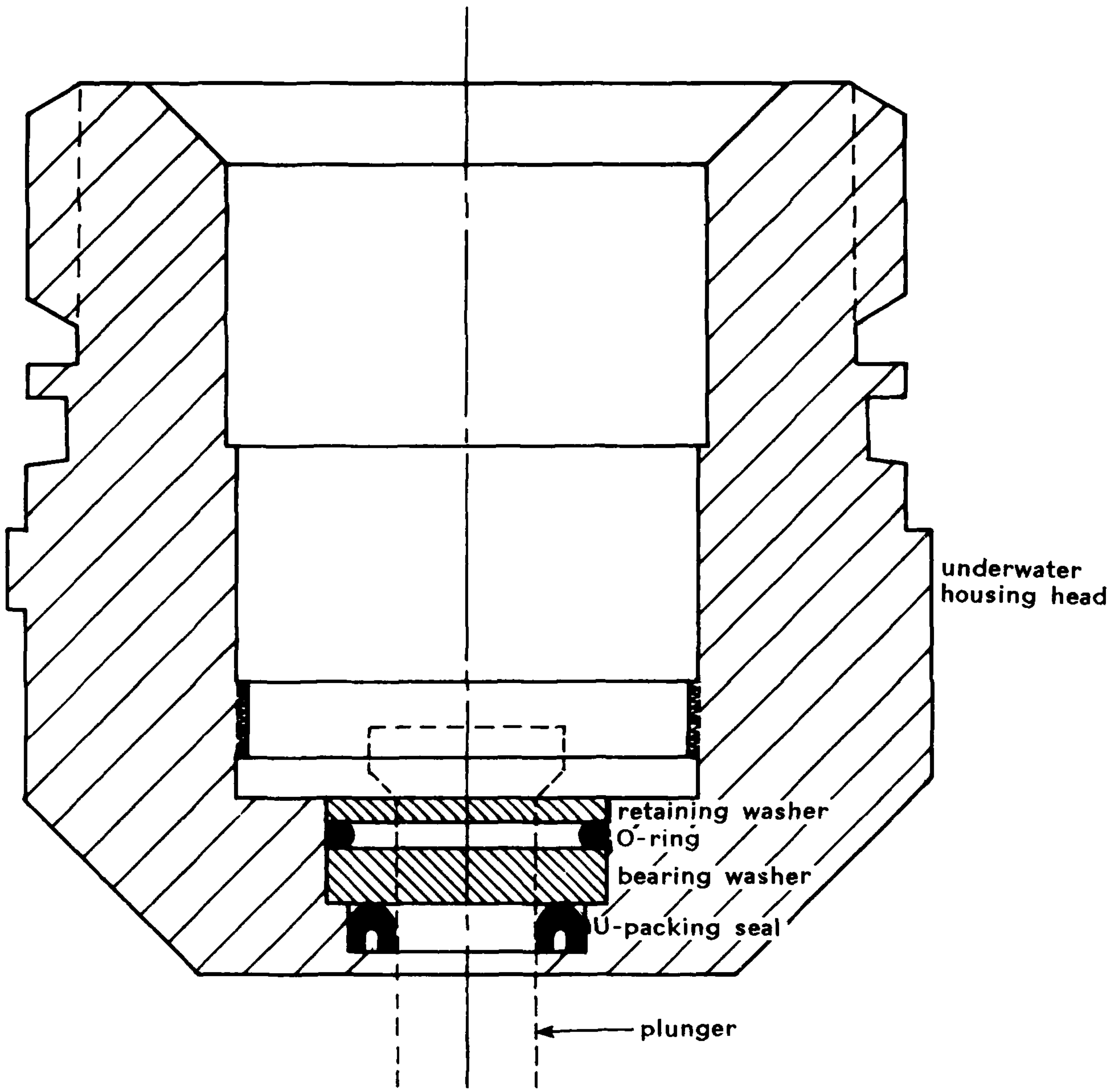


Figure 6.17. Detail of rock classifier underwater housing head showing placement of U-packing seal, bearing and retaining washers, and O-ring.

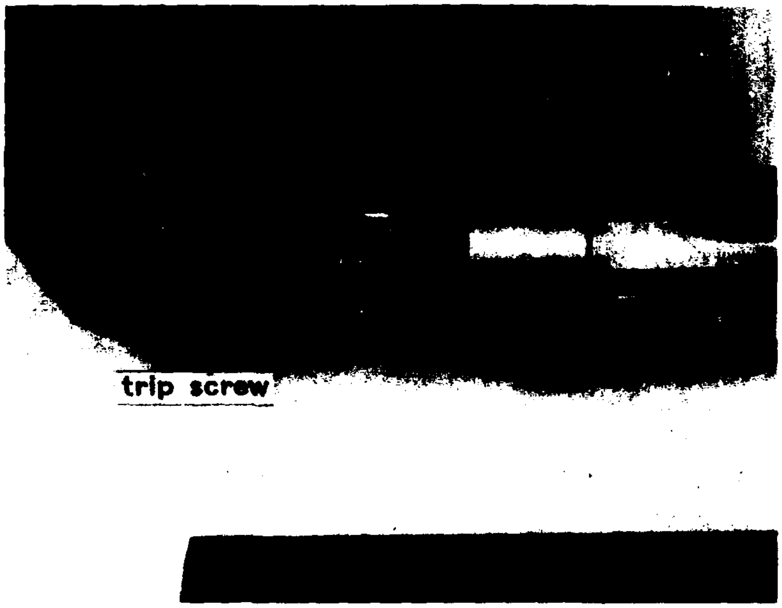


Figure 6.18. Trip screw in end cap of rock classifier used to adjust calibration reading.

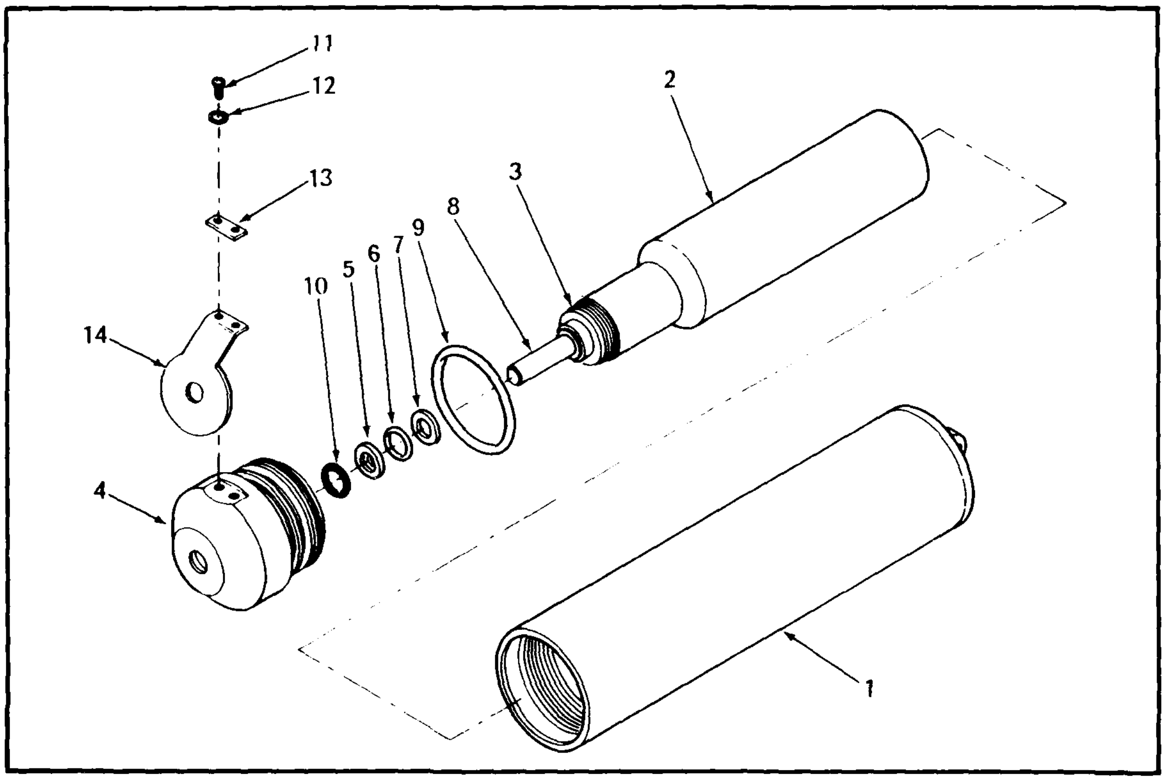
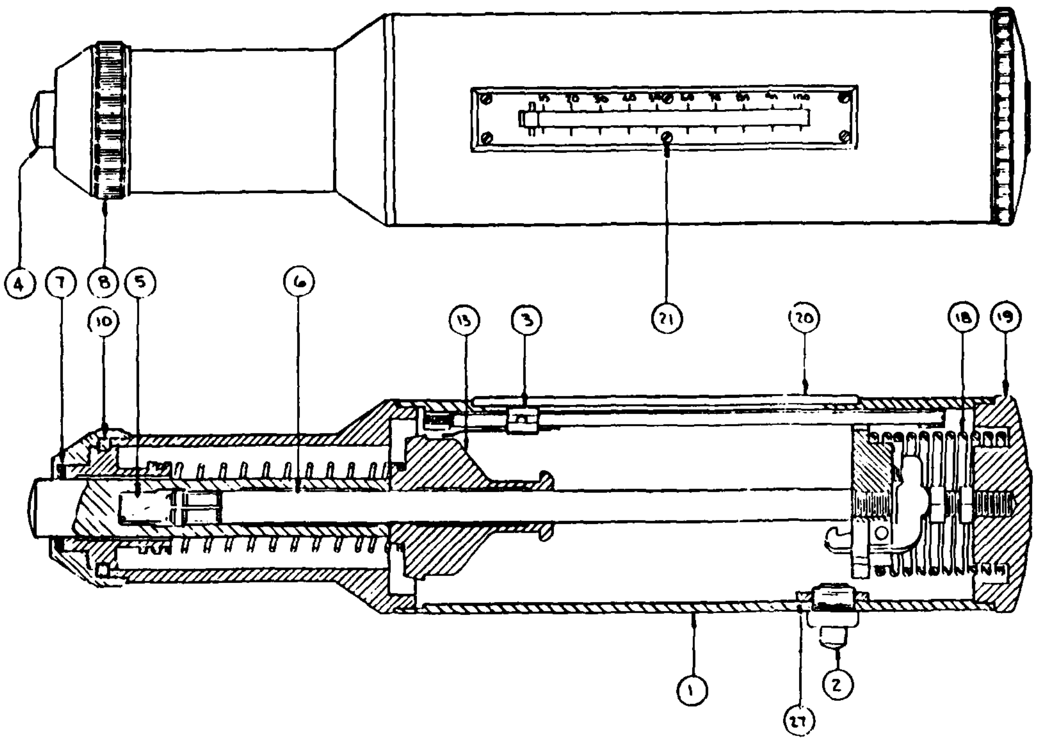


Figure 6.19. Rock classifier.



ITEM	PART NO.	REQ.	DESCRIPTION
27	CT320-AF	1	LOCKNUT 3437-0031
26	CT310-AE	1	POROUS STONE 9819-0018
25	CT310-AD	1	CARRYING CASE 9201-0027
24			
23			
22			
21	CT310-Z	6	#1-64 x 3/32 LG. FILL. HD. SCR. 9517-0029
20	CT320-AC	1	INDICATOR WINDOW 3437-0030
19	4417-0012	1	BODY END CAP ASSY.
18	CT310-AA	1	PLUNGER RETURN SPRING 3437-002A
17			
16			
15			
14			
13	4412-0009	1	HAMMER SPRING ASSY.
12			
11			
10	CT370-S	1	PLUNGER BUSHING RET. 3437-0020
9			
8	4412-0007	1	BODY REDUCER CAP
7	CT320-P	1	FELT WASHER 3437-0017
6	4412-0011	1	LATCH & PLUNGER ASS'Y.
5	CT320-N	1	PLUNGER SPRING 3437-0015
4	CT320-M	1	PLUNGER 3437-0013
3	3437-0043	1	INDICATOR & GUIDE ASS'Y.
2	CT310-SB	1	PUSH BUTTON ASSEMBLY
1	4412-0010	1	BODY & REDUCER ASSEMBLY

REVISIONS	SOILTEST INC.			
12-20-73 MGS	ASSEMBLY NAME ROCK TEST HAMMER			
	PART NAME 4412-0001			
	DRAWN RLR	CHECKED	APPROVED	DATE 1-31-67
	SCALE FULL	NO. REQ.	PART NO.	ASSEMBLY NO. RM-710

Figure 6.20. Soil test parts list.

6.7.2.4 Indent Column. The numbers 1 through 3 in the indent column show the relationship of parts and subassemblies to assemblies and/or installations. For any given figure, a number 1 indent item is the top level of an assembly or installation, and a number 3 indent is the lowest level of disassembly.

6.7.2.5 Description Column. The description column contains descriptions of all parts listed in the applicable drawings. Modifiers are included to identify the characteristics of a particular item. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference. A cross-reference appears both in the listing where the assembly is first described and in the listing in which the assembly is broken down. In the latter, the abbreviation REF appears in the quantity per assembly column. Abbreviations in the description column are generally in accordance with MIL-STD-12C and/or as noted in the list of abbreviations and acronyms.

6.7.2.6 Manufacturer's Code Column. The manufacturer's code column lists numbers identifying the suppliers of the parts. Table 6.3 lists both suppliers and codes, which are also available in the Federal Supply Code for Manufacturers, Cataloging Handbooks H4-1 and H4-2.

6.7.2.7 Quantity Per Assembly Column. The quantity per assembly column contains one of the following entries: a numeral indicating the quantity of the item used only at the indicated location or the abbreviation REF, indicating that the required quantity is listed on the figure referenced in the description column.

6.7.2.8 Used-On Code Column. This column will remain blank because there are no used-on codes applicable to this parts list.

6.7.3 Abbreviations and Acronyms

The abbreviations and acronyms listed in Table 6.4 appear in the parts list and in the text of this manual. Abbreviations used in the text may be in lower case letters, initial capitals with lower case letters, or all capitals. Abbreviations used in the parts list are in all capitals. The abbreviations and acronyms listed in Table 6.4 are in all capitals for consistency.

6.8 TOOL KIT

6.8.1 Introduction

This section explains the function of the rock classifier kit and presents a list of the contents and purpose of each item. Procurement information is given in Section 6.11. An Illustrated Parts Breakdown for the rock classifier housing is given in Section 6.7.

6.8.2 Tool Kit Function

The rock classifier tool kit is designed to be self-sufficient in the field with the exception of freshwater for cleaning, providing proper maintenance has been done. This tool kit is packaged in one box. This plywood box is 4 feet long, 2 feet wide, and 1.4 feet tall, for a total cube of 11.3 ft^3, and weighs 147 pounds. The kit contains (Figure 6.21) all the spare parts, repair parts, and supplies to maintain the tool in the field unless the hammer itself needs repair (done by OCEI).

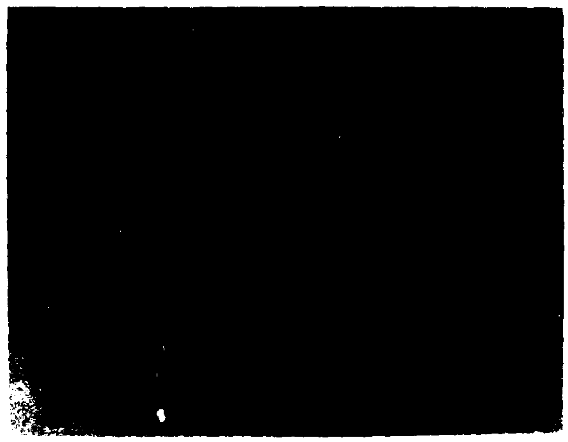


Figure 6.21. Rock classifier kit with contents out.

Table 6.3. List of Manufacturers' Codes, Names, and Addresses

Code	Name and Address
02697	Parker-Hannifin Corporation Seal Group, O-Ring Division 2360 Palumo Drive Lexington, KY 40509
30781	Parker-Hannifin Corporation Packing Division 2220 S. 3600 W. Salt Lake City, UT 84119
31995	Jenkins Bros. 101 Merritt 7 Norwalk, CT 06851
35708	Textron Canada LTD Homelite-Terry Division 180 Labrosse Avenue P.O. Box 1800 Pointe Claire, Que Can H9R 4R6
39428	McMaster-Carr Supply Company P.O. Box 4355 Chicago, IL 60680
75336	Kingston F.C. Company 1007 N. Main Street Los Angeles, CA 90012
80091	Naval Facilities Engineering Command Washington, DC 20370
80094	Smith Herman H., Inc. 1913 Atlantic Avenue Manasquan, NJ 08736
81646	Ideal Corporation Sub of Parker-Hannifin Corporation 1000 Pennsylvania Avenue Brooklyn, NY 11207
95760	Protective Closures Company, Inc. 2150 Elmwood Avenue Buffalo, NY 14207
98773	Soiltest, Inc. 2205 W. Lee Street Evanston, IL 60202

Table 6.4. List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AP	Attaching Part
ASSY	Assembly
ASTM	American Society for Testing and Materials
COML	Commercial
CONN	Connector
CRES	Corrosion Resistant Steel
DEG	Degree
DIA	Diameter
EXT	Extension
FEM	Female
FIG	Figure
FT	Feet
GA	Gage
GAPL	Group Assembly Parts List
ID	Inside Diameter
IN.	Inch/Inches
INSTL	Installation
IPB	Illustrated Parts Breakdown
L	Long
MSPT	Miniature Standard Penetration Test
NHA	Next Higher Assembly
NPT	National Taper Pipe (Thread)
OD	Outside Diameter
PT	Point
PVC	Polyvinyl Chloride
REF	Referenced
SQ	Square
SS	Stainless Steel
ST	Street
STD	Standard
SUBASSY	Subassembly
THD	Thread

6.8.3 Tool Kit Contents

A list of the rock classifier kit contents is given in Table 6.5. The kit contents are listed as they are placed in the box from back to front, left to right (Figure 6.22). The rock classifier in the underwater housing is shown in its box in Figure 6.23, and the spare rock classifier is in its box in Figure 6.24. A brief explanation of the function of each item in the kit is given in Table 6.6.

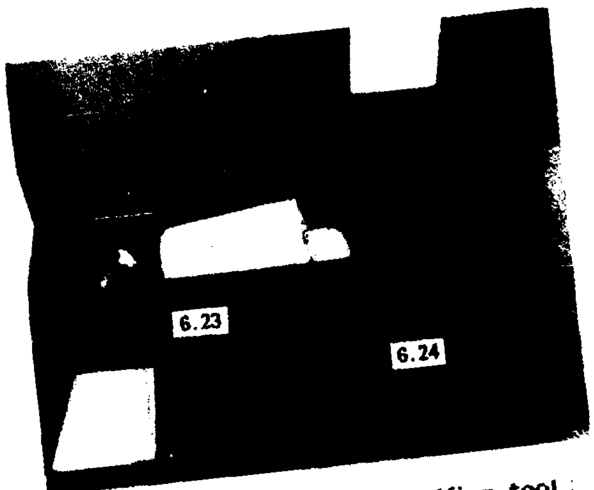


Figure 6.22. Rock classifier tool kit.

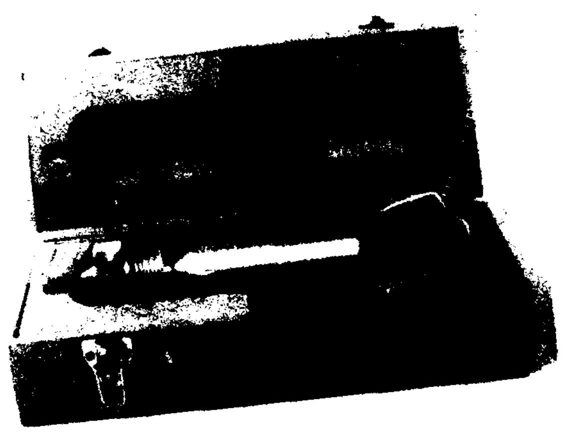


Figure 6.23. Rock classifier in underwater housing in it's tote box.

Figure 6.24. Spare rock classifier in it's tote box.

6.9 SHIPPING AND STORAGE

6.9.1 Introduction

The rock classifier tool and kit are designed to be stored in the kit box. The contents of the kit were selected to allow the box to be shipped by commercial and military truck, ship, and aircraft. However, shipping regulations change with time, so current regulations should be checked before shipping.

6.9.2 Storage

The contents of the kit shall be prepared for storage by ensuring that no moisture is inside the underwater housing of the tool or in the tool itself. The tool should be clean and dry. The housing head and outer end of the plunger should be coated with a rust preventative such as LPS-3. Be careful not to get the LPS-3 on the plunger inside the head where the U-packing seal and O-ring are since it will deteriorate them. This coating should be wiped off before using the tool. Maintenance should be performed on the tool while it is in storage at least once a year according to the instructions in Section 6.4.

Table 6.5. List of Contents - Rock Classifier Kit

Item	No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier	Manufacturer/Supplier Part Number
1	1	Kit box - rock classifier	6.30		83-30-1F		Local carpenter shop	
2	1	Plastic bucket (4 qt)						FSN 7240-00-061-1163
3	1	Silicone grease						FSN 6850-00-880-7616
4	1	Spray bottle - water						FSN
5	100	Rock classifier data sheets	B- (6.)					
6	5	Planning sheets	B-1					
7	5	Summary sheets	B-2					
8	5	Site data sheet	B-3					
9	5	Site sketch sheet	B-4					
10.	5	Tool fail. & inadeq. report	B-10					
11	2	Terry towel (pkg)						FSN 7920-00-823-9772
12	1	Box for underwater housing	6.29		83-31-1F	B-1	Local carpenter shop	
13	2	Rock classifier	6.20&6.28		81-2-1F	6,9	Soiltest	
14	1	Underwater housing	6.28	6.19	81-2-1F		Local machinist	
15	1	Rock pick, fiberglass handle					Plumb/Gardena Hardware	11-423
16	1	Chisel - 1-in. cold					Stanley/Gardena Hardware	18-847
17	2	Strap wrenches						FSN 5120-00-262-8481
18	50	Ziplock plastic bags, small					Local supplier	
19	1	Box for spare rock class.	6.29		83-31-1F	B-2	Local carpenter shop	
20	100	3x5 cards						FSN 7530-00-247-0318
21	12	Pencils, #1						FSN 7510-00-286-5757
22	2	Erasers						FSN 7510-00-323-8788
23	1	Protractor						FSN 6675-00-641-3166
24	1	Calibration anvil					Soiltest	CT-322
25	5	U-packing seals	6.28		81-2-1F	11	Parker	8404-0050-4180
26	5	O-rings	6.28		81-2-1F	10	Parker	2-230-70
27	5	Bearing washers	6.28,6.17		81-2-1F	8	Local machine shop	
28	5	Retaining washers	6.28,6.17		81-2-1F	15	Local machine shop	
29	5	O-rings	6.28,6.17		81-2-1F	14	Parker	2-015-70
30	10	Lock washers	6.28		81-2-1F	13	Local supplier	
31	6	Machine screws	6.28		81-2-1F	12	Local supplier	
32	1	Locking plate	6.28		81-2-1F	5	Local machinist	
33	2	Washer plates	6.28		81-2-1F	7	Local machinist	
34	1	Rock classifier slate	6.31					
35	1	Summary inst. sheet	6.15					
36	2	Calibration records	6.16					
37	1	List of contents	Table 6.5					

Table 6.6. Function of Kit Contents

Item	Description	Function in Kit
1	Kit box	Contain kit contents, shipping box
2	Plastic bucket	Hold water for cleaning tool
3	Silicone grease	Lubricate O-ring and U-packing seal
4	Spray bottle - water	Spray off tools
5	Rock classifier data sheets	Permanent record of data; transfer data from slate to data sheet; clean and reuse slate
6	Planning sheets	Plan a geotechnical site survey
7	Summary sheet	Summarize results from a site survey
8	Site data sheet	Record data location coordinates
9	Site sketch sheet	Sketch site and data locations; mark and label
10	Tool fail. & inadeq. report	Report problems with tools or kit
11	Terry towel	Clean and dry tool
12	Box for underwater housing	Protect rock classifier and underwater housing
13	Rock classifier	Tool that takes rock data (see Sections 6.2.4.1 and .2)
14	Underwater housing	Allows on-land tool to work underwater (see Sections 6.2.4.2 and .3)
15	Rock pick	Prepare rock surface for testing; chip off sample of rock
16	Chisel	Prepare rock surface for testing; chip off sample of rock
17	Strap wrench	Loosen underwater housing body from head
18	Ziplock plastic bags	Store rock chips taken at data location
19	Box for spare rock classifier	Store and protect spare rock classifier
20	3x5 cards	Label for rock chips in plastic bags
21	Pencil	Write on slate and data sheets
22	Eraser	Clean slate
23	Protractor	Guide for keeping rock classifier 90 deg from rock surface
24	Calibration anvil	Check calibration of rock classifier
25	U-packing seal	Seal around plunger to keep water out (spares)
26	O-ring	Seal around housing head and plastic body joint (spares)
27	Bearing washer	Inside end of plunger bears against (see Figure 6.17) (spares)
28	Retaining washer	Retains O-ring (item 29) against bearing washer (item 27) (see Figure 6.17) (spares)
29	O-ring	Acts as cushion for end of plunger when plunger is released (spares)
30	Lock washer	Locks machine screws holding locking plate onto head of housing (spares)
31	Machine screw	Fastens locking plate onto housing head (spares)
32	Locking plate	Retains plunger in depressed position, holding slider on scale at rebound number (spare)
33	Washer plate	Hold lock plate down on housing head
34	Rock classifier slate	Record rock classifier data underwater
35	Summary inst. sheet	Quick reference for field use
36	Calibration record	Record of calibration checks on rock classifiers
37	List of contents	Guide for packing and replacing kit parts

6.9.3 Shipping

Current shipping regulations should be checked before shipping the tool kit box. The only item in the rock classifier kit that requires special care for shipping is the lubricant/rust preventative LPS-3, but only when it is packaged in an aerosol can. Special packaging and permits for shipping can be avoided by using LPS-3 in bulk form with a hand spray bottle. By using the bulk LPS-3, the kit falls into the category of a combustible liquid. All that is required is marking the box "COMBUSTIBLE LIQUID."

The rock classifier tools should be inside the small padded boxes for shipping since they are a delicate instrument. The outer box should be marked HANDLE WITH CARE for shipping.

For shipping, the cube and weight of the rock classifier tool kit box are given below:

Rock Classifier Kit	11.3 ft^3	147 lb

6.10 DATA ANALYSIS

6.10.1 Introduction

The rock classifier data can be used to estimate the rock's compressive strength and tangent modulus. All the information presented for data analysis for the rock classifier is based on Technical Report No. AFWL-TR-65-116, "Engineering Classification and Index Properties For Intact Rock," by D.U. Deere and R.P. Miller.

6.10.2 Data Analysis

The data analysis procedure given here includes some simple laboratory work and calculations.

1. From the diver's data sheet, look for notes on use of the geology pick and use Table 6.6 to estimate the rock's hardness.

2. Use rock chips collected by the divers for visual identification of rock type. A geologist may need to be consulted for this.

3. Determine the rock's dry unit weight as follows:

(a) Weigh the rock chip in air, weight = a, by suspending it with a string or wire.

(b) Weigh the suspended rock chip submerged in distilled water at 4°C, weight = b.

(c) Calculate dry unit weight with the following equation:

$$\text{dry unit weight} = [a/(a-b)] \times 62.4 \text{ lb/ft}^3$$

4. Use the dry unit weight of the rock and Figure 6.25 to estimate compressive strength. Find the rock type from Table 6.7 and use one close to what the rock is identified as by visual identification.

5. The rock classifier data were recorded on the data sheets as R. There should be 10 values of R for each data location. Since the rock classifier errors on the low side, the five lowest values of R (or lowest half if less than 10) should be disregarded. The high five values of R should be averaged to obtain the final value of R = R_f, for that data location. This R_f along with the dry unit weight can be used to estimate the rock's compressive strength using Figure 6.26. Compare this to your estimate obtained in step 4. To see if you are in the right range, use R_f and Figure 6.27 to estimate the rock's tangent modulus.

6. Check the data sheet for the calibration of the rock classifier on the calibration anvil, R_{cal}. The calibration average should be in the proper range for that particular anvil, N ± 2 (N should be recorded on the data sheet by the divers). If the R_{cal} is not equal to N ± 2, then the data, R_f, must be corrected according to the equation below to obtain the corrected value of $R_f = R_{fc}$:

$$R_{fc} = \left(\frac{S\,R}{n}\right)\left(\frac{N_r}{R_{cal}}\right)$$

where: R_{fc} = final corrected rebound number

R = rebound numbers read at data location (high five values)

N_r = rock calibration anvil number (for rock classifier = N_c - 17) where N_c = $N_{concrete}$ (written on anvil)

R_{cal} = averaged rebound number for rock classifier on calibration anvil

n = number of rebound numbers, R, being summed ($SR/n = R_f$)

7. Using the estimated compressive strength and tangent modulus, Table 6.8 can be used to find the strength range of the rock.

6.11 PROCUREMENT INFORMATION

6.11.1 Introduction

All the necessary information to procure the rock classifier, the rock classifier kit, and its contents is contained within this manual. The information can be found in the following locations:

Table 6.5	List of Contents - Rock Classifier Kit
Section 6.7	Illustrated Parts Breakdown - Rock Classifier
Section 6.11.2	Purchase Description
Section 6.11.3	Manufacturers/Suppliers
Section 6.11.4	Drawings
Appendix B	Data Sheets

Table 6.5 can be used as a master list to procure anything in the kit. Within the table is information such as drawings, manual figure numbers, part numbers, and manufacturers.

6.11.2 Purchase Description

1. SCOPE. This purchase description establishes the requirements for the manufacture and acceptance of the geotechnical diver tools. The geotechnical tools consist of a miniature standard penetration test (MSPT) device, vane shear, impact corer, vacuum corer, jet probe, and rock classifier.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this purchase description to the extent specified herein.

DRAWINGS

Figure No.	NCEL Drawing No.	Title
6.28	81-2-1F	Rock Classifier
6.29	83-31-1F	Tote Boxes for Rock Classifiers
6.30	83-30-1F	Kit Box for Rock Classifiers
6.31	--	Diver Slate - Rock Classifier

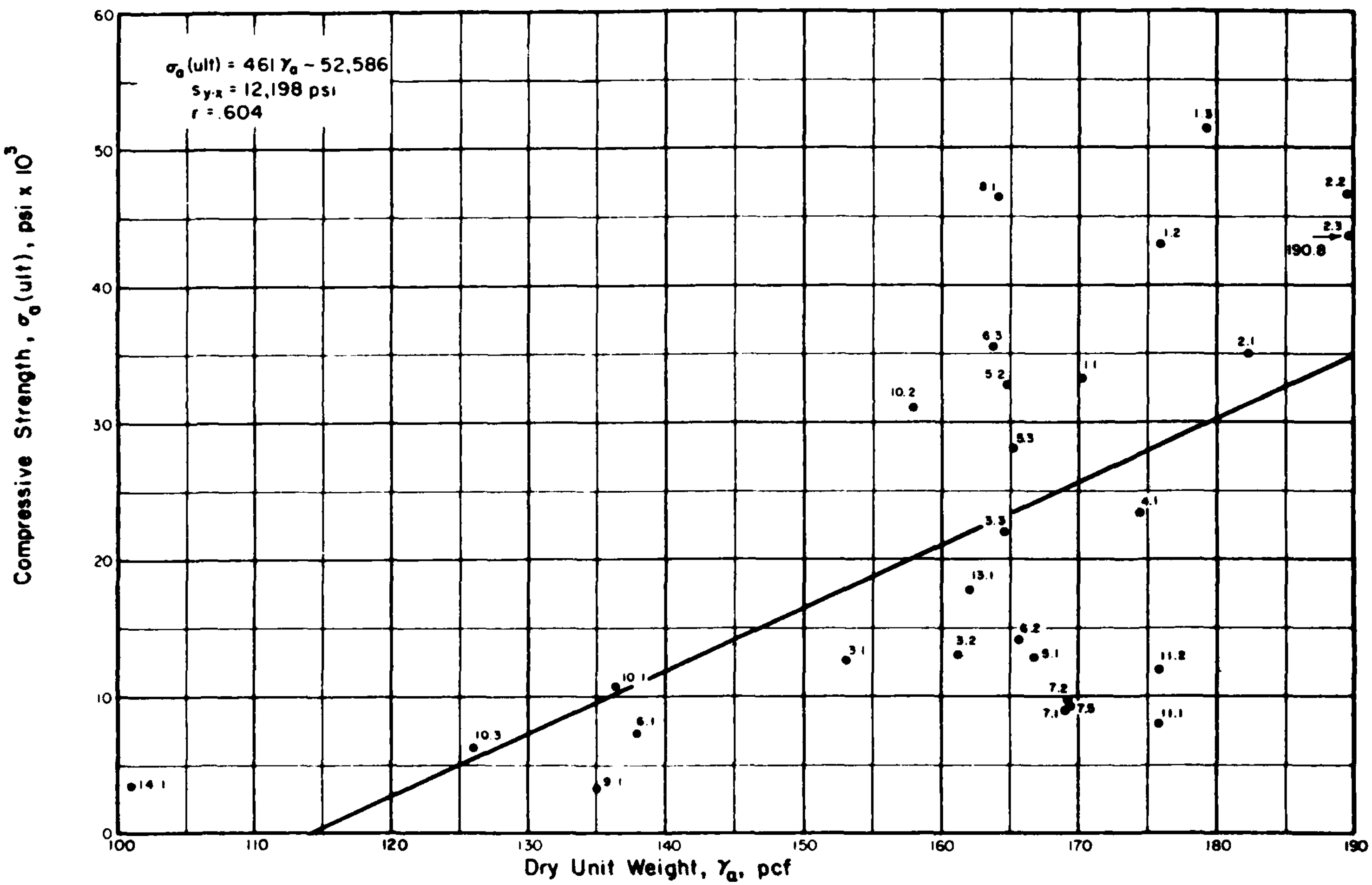


Figure 6.25. Relationship between average values of dry unit weight and ultimate compressive strength for rock in uniaxial compression (from Deere and Miller, 1966).

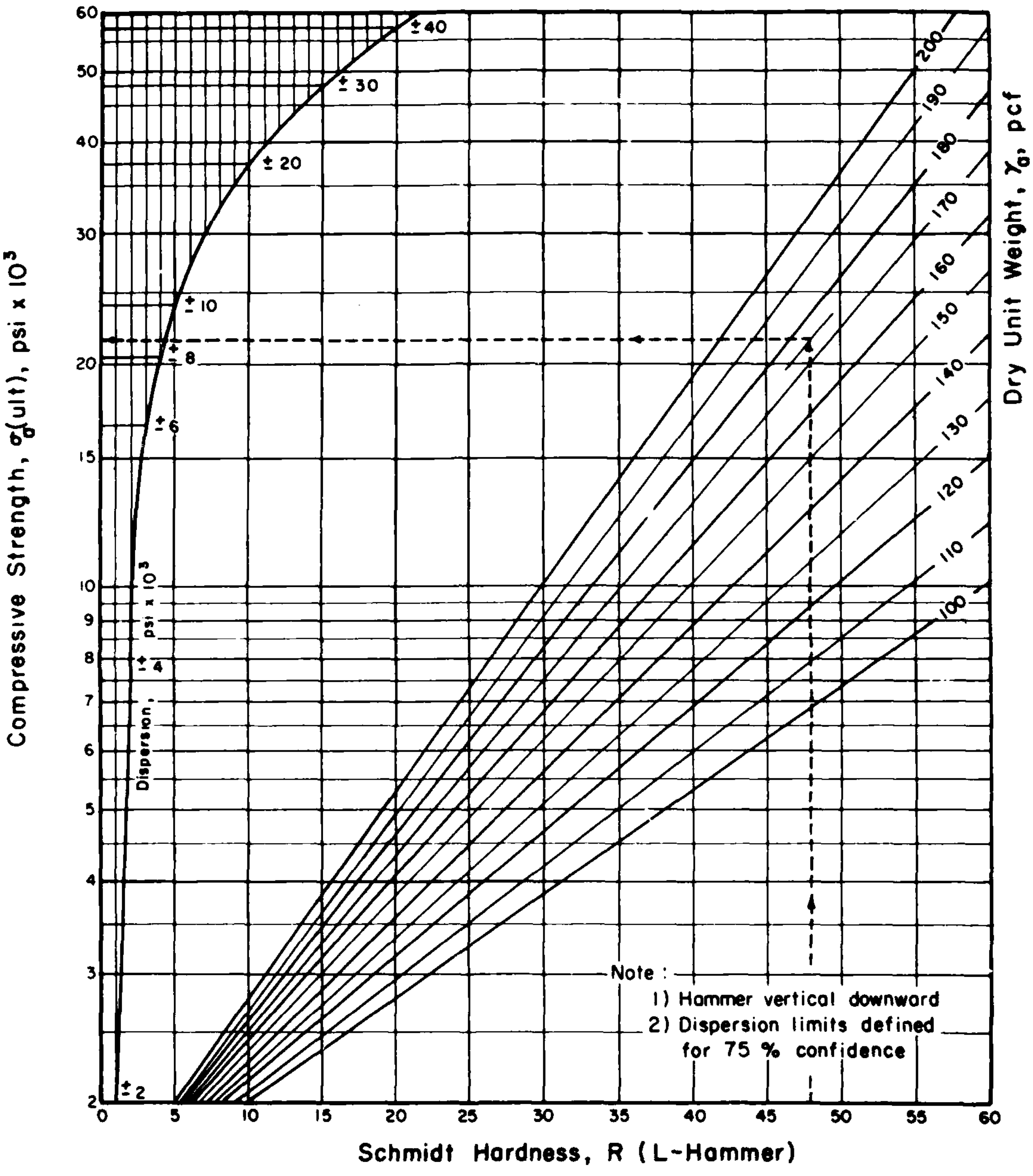


Figure 6.26. Rock strength chart based on Schmidt hardness. Example: For R_f = 48, and unit weight of 175 pcf, the compression strength is estimated at 21,500 which may vary as much as ± 8,500 psi (from Deere and Miller, 1966).

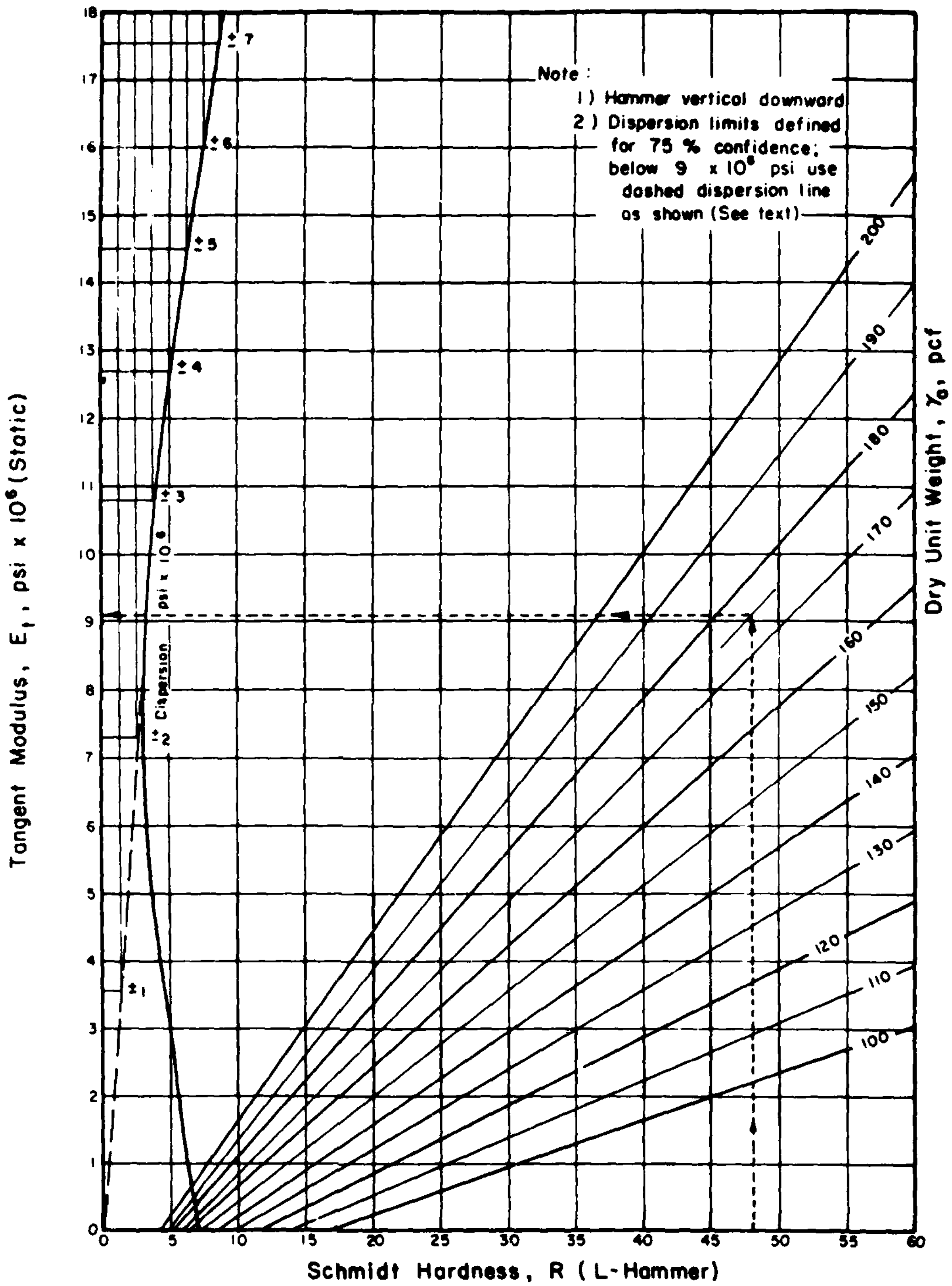


Figure 6.27. Rock modulus chart based on Schmidt hardness. Example: For R_f = 48, and unit weight of 175 pcf, the tangent modulus is estimated at 9.0 x 10^6 psi which may vary as much as ± 2.4 x 10^6 psi (from Deere and Miller, 1966).

Table 6.7. List of Rock Types (from Deere and Miller, 1966)

Group No.	Rock Type (Name)	Location	No. Specimens
1.1	Basalt (Lower Granite)	Pullman, Wash.	12
1.2	Basalt (Little Goose)	Walla Walla, Wash.	6
1.3	Basalt (John Day)	Arlington, Ore.	6
2.1	Diabase (Palisades)	West Nyack, N.Y.	12
2.2	Diabase (Coggins)	Culpeper, Va.	6
2.3	Diabase (French Creek)	St. Peters, Pa.	6
3.1	Dolomite (Oneota)	Kasota, Minn.	12
3.2	Dolomite (Lockport)	Niagara Falls, N.Y.	6
3.3	Dolomite (Bonne Terre)	Bonne Terre, Mo.	6
4.1	Gneiss (Dworshak)	Orofino, Idaho	12
5.1	Granite (Pikes Peak)	Colorado Springs, Colo.	6
5.2	Granite (Pikes Peak)	Colorado Springs, Colo.	6
5.3	Granite (Barre)	Barre, Vt.	12
6.1	Limestone (Bedford)	Bedford, Ind.	12
6.2	Limestone (Ozark Tavernelle)	Carthage, Mo.	12
6.3	Limestone (Solenhofen)	Solenhofen, Bavaria	6
7.2	Marble (Taconic White)	West Rutland, Vt.	12
7.2	Marble (Cherokee)	Tate, Ga.	6
7.5	Marble (Imperial Danby)	West Rutland, Vt.	13
8.1	Quartzite (Baraboo)	Baraboo, Wis.	7
9.1	Rock Salt (Diamond Crystal)	Jefferson Island, La.	6
10.1	Sandstone (Berea)	Amherst, Ohio	12
10.2	Sandstone (Crab Orchard)	Crossville, Tenn.	9
10.3	Sandstone (Navajo)	Glen Canyon, Ariz.	12
11.1	Schist (Luther Falls) I	Unknown Origin	12
11.2	Schist (Luther Falls) II	Unknown Origin	6
13.1	Siltstone (Hackensack)	Hackensack, N.J.	12
14.1	Tuff (NTS-E Tunnel)	Mercury, Nev.	12
TOTAL			257

NOTES:

1.1 Basalt (Lower Granite), Pullman, Wash.
Dark gray, massive, compact to vesicular basalt; interlocking, crystalline texture. Core samples from dam-site on the Snake River.

1.2 Basalt (Little Goose), Walla Walla, Wash.
Very dark gray, massive, compact to vesicular basalt; interlocking, crystalline texture. Core samples from dam-site on the Snake River.

1.3 Basalt (John Day), Arlington, Ore.
Very dark gray to black, massive, compact to vesicular basalt; interlocking, crystalline texture. Some flows of this rock are very highly vesicular; however, the specimens selected for testing contained few or no vesicles. Core samples from dam-site on the Columbia River.

Continued

Table 6.7. Continued

2.1 Diabase (Palisades), West Nyack, N.Y.
Black with lighter gray, speckled appearance, medium-grained, dense, massive diabase; tightly interlocking, crystalline texture. Block sample from New York Trap Rock Corporation quarry, located in sill intrusion in Newark Group of Late Triassic age.

2.2 Diabase (Coggins), Culpeper, Va.
Dark gray with lighter gray, speckled appearance, medium-grained, dense, massive diabase; tightly interlocking, crystalline texture. Block sample from Coggins Granite Industries quarry in Allegheny Mountains near Culpeper.

2.3 Diabase (French Creek), St. Peters, Pa.
Dark gray to black with lighter gray, speckled appearance, medium-grained, dense, massive diabase; tightly interlocking, crystalline texture. Block sample from French Creek Granite Company, Inc.

3.1 Dolomite (Oneota), Kasota, Minn.
Buff, fine-grained, massive, porous dolomite; slightly mottled appearance from small, irregular, white veins of calcite; predominantly granular, interlocking texture. Block sample from The Babcock Company.

3.2 Dolomite (Lockport), Niagara Falls, N.Y.
Gray to dark gray, very fine-grained, slightly porous, massive dolomite, containing small infrequent blebs of anhydrite; texture intermediate between cemented-granular and interlocking crystalline. Block sample from Niagara Stone Division, McLain Industries, Inc.

3.3 Dolomite (Bonne Terre), Bonne Terre, Mo.
Yellowish buff, extra fine-grained, compact dolomite, containing numerous, narrow to very fine calcite-filled fracture veins that are well-healed; interlocking, crystalline texture. Block sample from Valley Dolomite Corporation.

4.1 Gneiss (Dworshak), Orofino, Idaho
Black and white, fine- to medium-grained granodiorite gneiss, with foliation making an angle of 45 deg with the axis of the core. Somewhat interlocking, foliated, crystalline texture. Core samples from dam-site located in the Orofino series on the North Fork Clearwater River.

5.1 Granite (Pikes Peak), Colorado Springs, Colo.
Predominantly pink with small, irregular, dark patches of biotite mica, coarse-grained, weathered granite; interlocking, crystalline texture. Core samples from NORAD project, Cheyenne Mountain.

5.2 Granite (Pikes Peak), Colorado Springs, Colo.
Gray and pink, fine- to medium-grained, fresh, dense granite; tightly interlocking, crystalline texture. Core samples from NORAD project, Cheyenne Mountain.

continued

Table 6.7. Continued

5.3 Granite (Barre), Barre, Vt.
Uniform gray, black, and white, medium-grained, fresh, dense granite; interlocking, crystalline texture. Block samples from Rock of Ages Corporation.

6.1 Limestone (Bedford), Bedford, Ind.
Very light grayish buff, slightly porous, oolitic bioclastic limestone; cemented texture of rounded fossil shells. Block sample from Indiana Limestone Company, Inc.

6.2 Limestone (Ozark Tavernelle), Carthage, Mo.
Light uniform gray, fine-grained, compact limestone, containing numerous fossil shell fragments; cemented, crystalline texture. Block sample from Carthage Marble Corporation.

6.3 Limestone (Solenhofen), Solenhofen, Bavaria
Light grayish buff, extremely fine-grained, massive, lithographic limestone, containing lighter, thin, uniformly distributed "bedding" streaks. Tight, interlocking, crystalline texture. Block samples from U.S. Geological Survey necessitated coring parallel to bedding because of size and shape.

7.1 Marble (Taconic White), West Rutland, Vt.
Very pure white, uniform, fine-grained, massive, saccharoidal marble; tightly interlocking, crystalline texture. Block sample from Vermont Marble Company.

7.2 Marble (Cherokee), Tate, Ga.
Light grayish white, medium- to coarse-grained, massive marble; tightly interlocking, crystalline texture. Block sample from the Georgia Marble Company.

7.5 Marble (Imperial Danby), West Rutland, Vt.
Off-white, medium-grained, massive marble, containing infrequent patches of dark impurities; tightly interlocking, crystalline texture. Block sample from Vermont Marble Company.

8.1 Quartzite (Baraboo), Baraboo, Wis.
Pinkish gray to purple, fine-grained, brittle, semi-vitreous, massive Pre-Cambrian quartzite, containing numerous undulatory bedding surfaces; tightly interlocking, crystalline texture. Block sample from Baraboo Quartzite Company, Inc.

9.1 Rock Salt (Diamond Crystal), Jefferson Island, La.
Grayish white, translucent, very coarse-grained, massive rock salt; interlocking texture. Block sample from Diamond Crystal Salt Company.

Continued

Table 6.7. Continued

10.1 Sandstone (Berea), Amherst, Ohio
Light gray, fine-grained, massive, slightly porous sandstone, containing very fine, light orange, uniformly to randomly distributed flecks; cemented to partially interlocking texture of subangular to rounded quartz grains. Block sample from Cleveland Quarries Company.

10.2 Sandstone (Crab Orchard), Crossville, Tenn.
Light reddish brown, very fine-grained, compact quartzose sandstone; tightly interlocking texture. Core axis parallel to bedding planes. Block samples from Luther Falls Stone Company, Urbana, Ill., and Crab Orchard Stone Company, Inc.

10.3 Sandstone (Navajo), Glen Canyon, Ariz.
Orange-red to brown, porous, fine- to medium-grained, friable sandstone; loose hematite-cemented texture of subrounded quartz grains. Core samples from dam-site on the Colorado River.

11.1 Schist (Luther Falls) I, Unknown origin
Light to dark gray quartz-mica-schist. Extreme crenulations visible on sides of core specimens, which were cored perpendicular to the foliation. Numerous garnets visible throughout. Interlocking, crystalline quartz texture, interspersed with micaceous foliation planes. Block sample from Luther Falls Stone Company, Urbana, Ill. Exact origin is unknown; however, this schist resembles the Manhattan schist in essentially all respects.

11.2 Schist (Luther Falls) II, Unknown origin
Description as above except axis of each core parallels foliation planes.

13.1 Siltstone (Hackensack), Hackensack, N.J.
Dark reddish brown, massive, compact, clayey siltstone; some more sandy and some more shaly phases; clay- and hematite-rich, cemented texture. Core samples from frozen-in-ground gas storage facility in Hackensack Meadows, located in Newark Series of Triassic age.

14.1 Tuff (NTS-E Tunnel), Mercury, Nev.
Very light pink, porous tuff, containing uniformly distributed, white, dark gray, and a few random, brown, lithic fragments; cemented texture and a very low density rock. Block sample from Nevada Test Site.

Table 6.8. Engineering Classification for Intact Rock (from Deere and Miller, 1966)

Class[a]	Description	Uniaxial Compressive Strength (lb/in.^{2})	Modulus Ratio[b]
On Basis of Strength			
A	Very high strength	Over 32,000	
B	High strength	16,000-32,000	
C	Medium strength	8,000-16,000	
D	Low strength	4,000-8,000	
E	Very low strength	Less than 4,000	
On Basis of Modulus Ratio			
H	High modulus ratio		Over 500
-	Average modulus ratio		200-500
L	Low modulus ratio		Less than 200

[a]Classify rock as B, BH, BL, etc.

[b]Modulus Ratio = E_t/σ_a(ult).

where: E_t = tangent modulus at 50% ultimate strength

σ_a = uniaxial compressive strength

(Copies of drawings required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this purchase description and the references cited herein, the text of this purchase description shall take precedence.

3. REQUIREMENTS

3.1 Drawings. The drawings referenced in 2.1.2 are level 2 end-product drawings. No deviation from the prescribed dimensions or tolerances is permissible without prior approval of the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation. Any data (such as shop drawings, layouts, flow sheets, and processing procedures) that are prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 Dimensions. All tool dimensions shall conform to the requirements specified in the end product drawings referenced in 2.1.2.

3.3 Materials. Materials shall be as specified herein and in other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this purchase description. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Materials shall conform to the requirements specified in the end product drawings listed in 2.1.2.

3.4 Workmanship. All parts, components, and assemblies of the geotechnical tools, including machined surfaces, seals, and welded parts, shall be clean and free from any defects in workmanship. External surfaces shall be free from burrs, slag, sharp edges, and corners except where sharp edges or corners are required.

3.5 Interchangeability. All parts referenced in the drawings in 2.1.2 that are described by the same part number shall be physically and functionally interchangeable.

3.6 Assembly. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.7 Threaded connections and fasteners. No threaded connections or fasteners shall show evidence of cross threading or mutilation.

3.8 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.9 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.10 Weights. Where indicated in drawings, weights of parts and subassemblies must be maintained within tolerances stated.

3.11 Seals. Where indicated in drawings, seals shall be installed with the necessary care required to maintain the watertight integrity of the tool.

3.12 Finish. All finishes shall conform to specifications shown in the drawings listed in 2.1.2 and shall be free from nicks, burrs, and surface defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified

herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The contractor is responsible for ensuring that components and materials used are manufactured, examined, and tested in accordance with the referenced sections of this purchase description. Each part, subassembly, and assembly shall be inspected according to the inspection requirements specified in Table I.

4.3 Inspection procedure.

4.3.1 Dimensional verification. All components shall be checked for conformance with the dimensions and tolerances specified in the drawings referenced in 2.1.2. Measurement shall be conducted using instruments capable of measurements of ± 0.001 inch.

4.3.2 Visual inspection. Visual inspection shall be performed for compliance with material and workmanship requirements specified in the drawings referenced in 2.1.2.

4.3.3 Mechanical assembly. Component assembly shall be conducted to verify form, fit, and function of individual manufactured components.

4.3.4 Weighing. Components that have weights specified in the drawings referenced in 2.1.2 shall be checked using a standard certified scale capable of ± 0.1 percent accuracy.

4.4 Inspection failure. Failure of production geotechnical tools to meet any requirement specified herein during and as a result of the specified inspection shall be cause for rejection of the production tools and shall be cause for refusal by the Government to continue acceptance of production tools until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

5. PREPARATION FOR SHIPMENT

5.1 Preservation and packaging. All parts and subassemblies shall be preserved and packaged in accordance with MIL-STD-1188.

6.11.3 Manufacturers/Suppliers. Space is left for you to write in local suppliers

NEDOX CR PLUS PLATE

Suppliers:

General Magnaplate Corp.
2707 Palma
Ventura, CA 93003
(805) 642-6262

1331 U.S. Route 1
Linden, NJ 07036
(201) 862-6200

801 Avenue G East
Arlington, TX 76011
(817) 649-8989

OTHER HARDWARE

Gardena Hardware
17010 S. Vermont
Gardena, CA 90247
(213) 321-2854

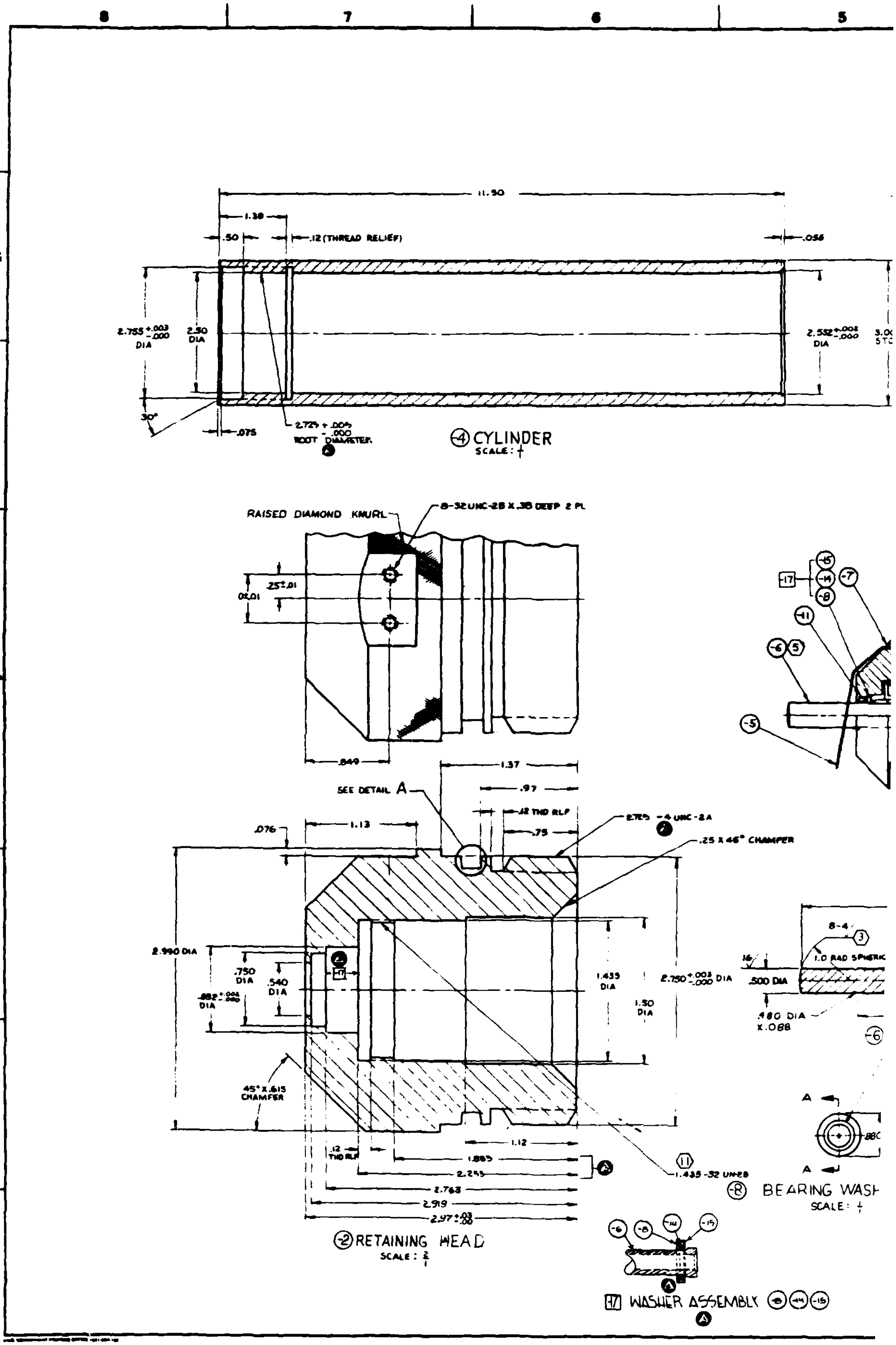
6.11.4 Drawings

The following drawings are included in this section:

Figure No.	NCEL Drawing No.	Title
6.28	81-2-1F	Rock Classifier
6.29	83-31-1F	Tote Boxes for Rock Classifiers
6.30	83-30-1F	Kit Box for Rock Classifiers
6.31	--	Diver Slate - Rock Classifier

Table I. Inspection and Test Requirements

Inspection	Number of Sample Units	Requirement Paragraph	Method Paragraph	Number of Failures Allowed
Dimensions not as specified	All units	3.2	4.3.1	None
Materials not as specified	All units	3.3	4.3.2	None
Workmanship not as specified	All units	3.4	4.3.2	None
Interchangeability	All units	3.5	4.3.1	None
Assembly	All units	3.6	4.3.3	None
Threaded connections and fasteners	All units	3.7	4.3.2	None
Welding	All units	3.8	4.3.2	None
Bolted connections	All units	3.9	4.3.2	None
Required component weights	All units	3.10	4.3.4	None
Seals	All units	3.11	4.3.2	None
Finish	All units	3.12	4.3.2	None



11.50
1.38
.50
.12 (THREAD RELIEF)
.056
2.755 +.003 -.000 DIA
2.50 DIA
2.552 +.003 -.000 DIA
30°
.075
2.729 + .005 -.000 ROOT DIAMETER
-4 CYLINDER
SCALE: 1/1
RAISED DIAMOND KNURL
8-32UNC-2B X.38 DEEP 2 PL
.25±.01
.849
1.37
SEE DETAIL A
.97
.12 THD RLF
.75
2.755 -4 UNC-2A
.25 X 45° CHAMFER
.076
1.13
2.990 DIA
.750 DIA
.540 DIA
1.435 DIA
2.750 +.003 -.000 DIA
1.50 DIA
45° X.615 CHAMFER
.12 THD RLF
1.12
1.885
2.255
2.763
2.919
2.97 +.03 -.00
1.435-32 UN-2B
-2 RETAINING HEAD
SCALE: 2/1
-17 WASHER ASSEMBLY
-8 BEARING WASH
SCALE: 1/1
1.0 RAD SPHERIC
.500 DIA
.480 DIA X.088
A

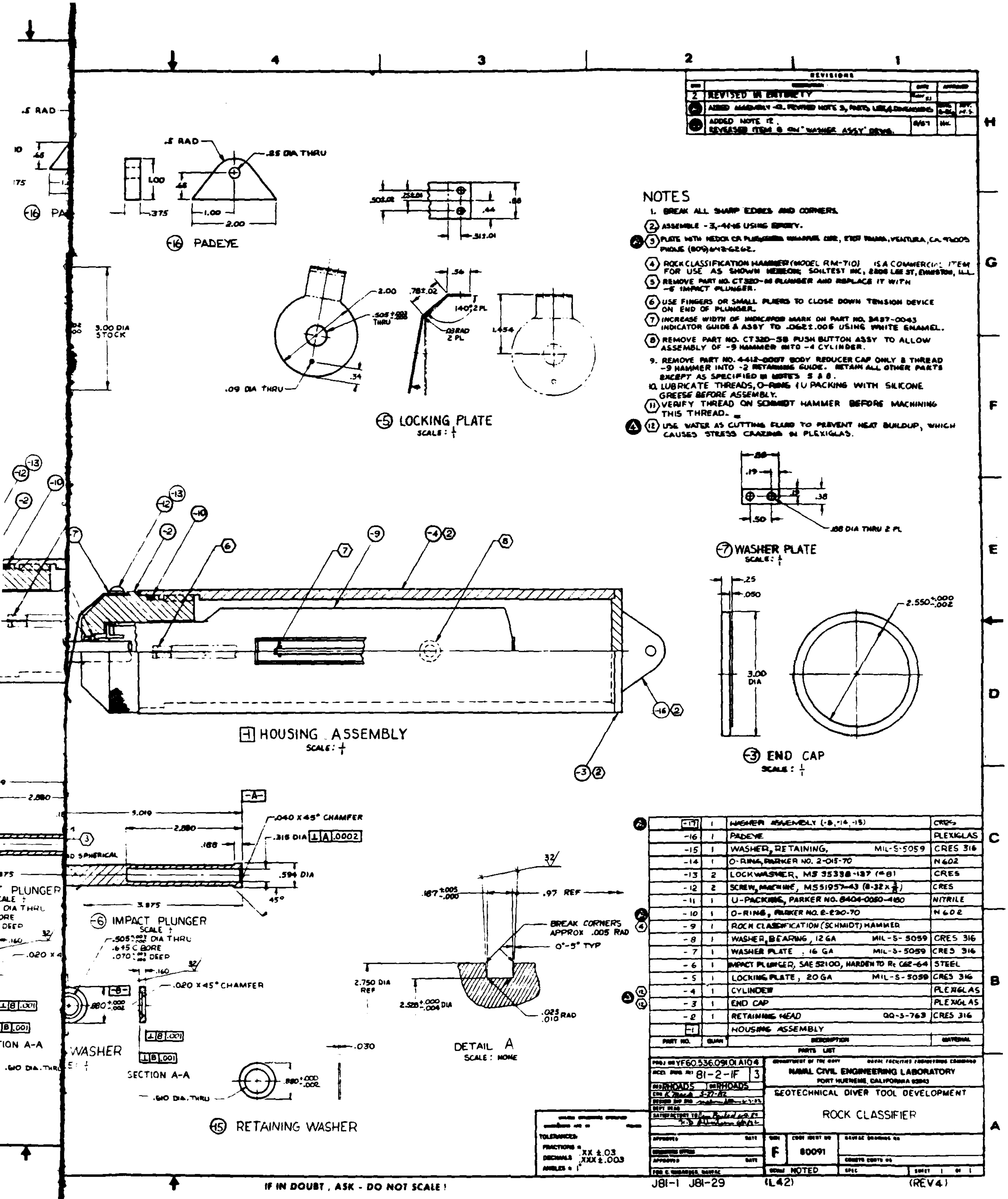
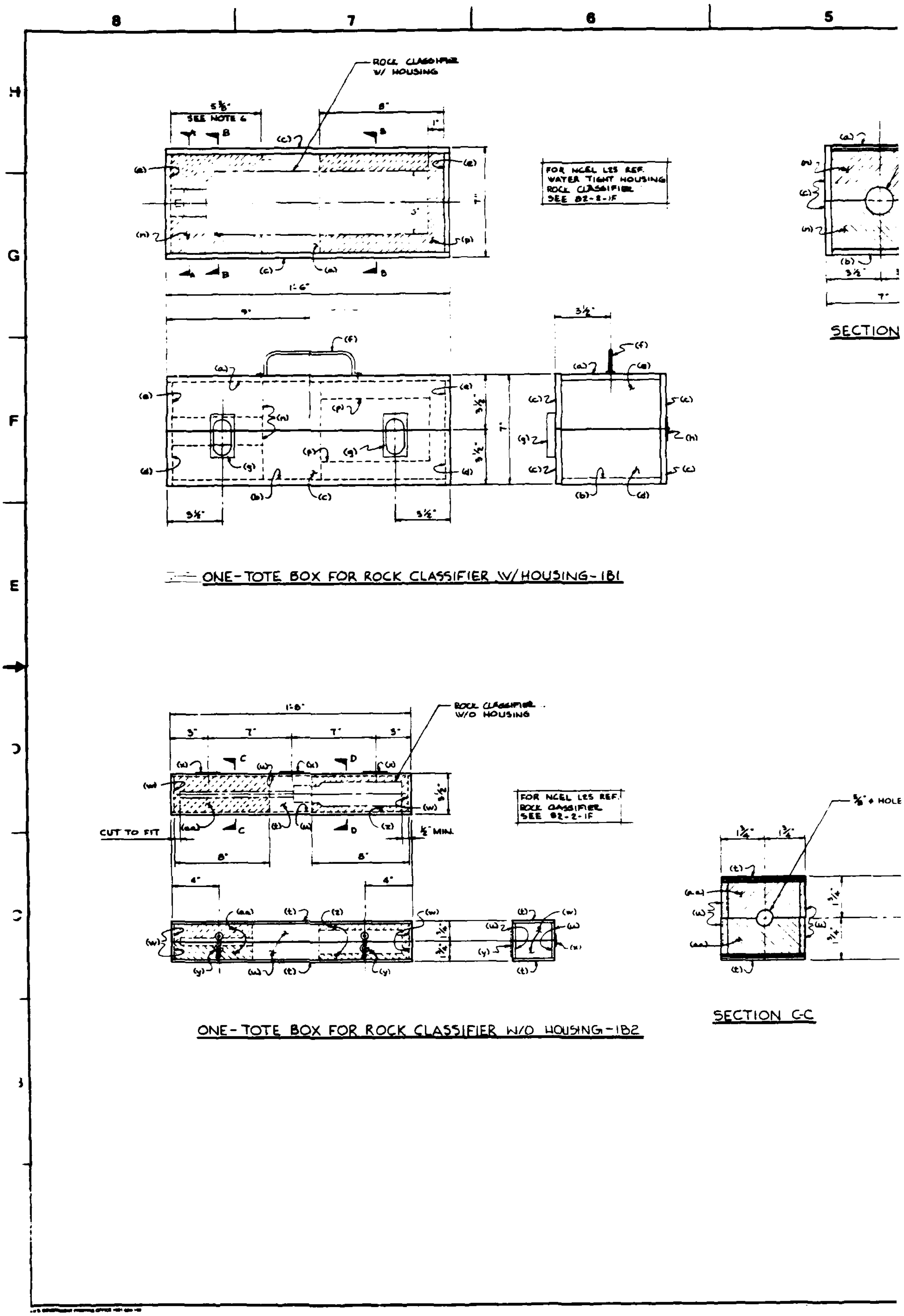
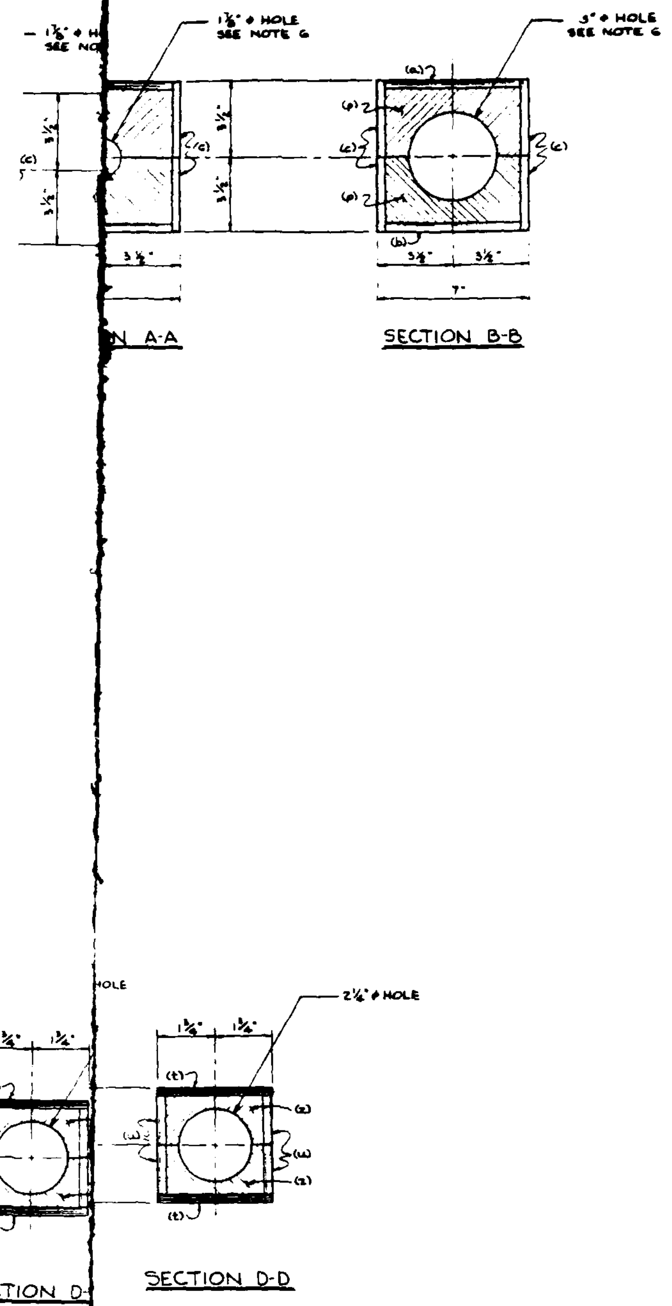


Figure 6.28. Rock classifier.


8
7
6
5
H
G
F
E
ROCK CLASSIFIER W/ HOUSING
SEE NOTE 6
FOR NCEL L25 REF. WATER TIGHT HOUSING ROCK CLASSIFIER SEE 82-2-1F
SECTION
ONE-TOTE BOX FOR ROCK CLASSIFIER W/HOUSING-1B1
ROCK CLASSIFIER W/O HOUSING
FOR NCEL L25 REF. ROCK CLASSIFIER SEE 82-2-1F
CUT TO FIT
1/2" MIN.
5/8" ϕ HOLE
SECTION C-C
ONE-TOTE BOX FOR ROCK CLASSIFIER W/O HOUSING-1B2



REVISIONS

NOTES:

1. ALL PLYWOOD SHALL BE: STRUCTURAL I, C-C EXTERIOR.
2. ALL ROUGH EDGES & CORNERS ON PLYWOOD SHALL BE SANDED SMOOTH.
3. ALL PROTRUDING WOOD SCREWS SHALL BE GROUND FLUSH.
4. ALL WOOD JOINTS SHALL BE GLUED & NAILED. SPACE 4d NAILS @ 2" ON CENTERS.
5. APPLY PLASTIC WOOD COMPOUND TO ALL PLYWOOD EDGES. PRIME & COAT ALL WOOD SURFACES & EDGES WITH EXTERIOR PAINT, FINISH COLOR TO BE GRAY.
6. VERIFY DIMENSIONS WITH EXISTING ROCK CLASSIFIER & HOUSING TEST FIT BOTH BOXES CONTACT L42 FOR ROCK CLASSIFIER & HOUSING.
7. GLUE POLYURETHANE FOAM TO BOX. SPRAY TEFLON ON POLY. FOAM. THE ROCK CLASSIFIER & HOUSING SHALL NOT STICK TO POLY. FOAM.

	MARK	NO REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS
6	aa	2	3 × 1½	0	8	POLYURETHANE FOAM, FIRM DENSITY
	-	A/R	2d NAILS			STAINLESS STEEL 18-8
	-	A/R	GLUE			WATERPROOF RESORCINAL
6	z	2	3 × 1½	0	8	POLYURETHANE FOAM FIRM DENSITY
	y	2	¾ × 1⅞			BRASS HOOK & STAPLE W/ BRASS SCREWS
	x	5	1" × .045" THK	0	2	CABINET HINGES, BRASS DULL BRASS FINISH, W/ BRASS SCREWS
	w	4	¼ × 1½	0	5	PLYWOOD
	u	4	¼ × 1½	1	8	"
	t	2	¼ × 5½	1	8	PLYWOOD
ONE-TOTE BOX FOR ROCK CLASSIFIER - 1B2						
6	p	2	6¼" × 3⅝	0	8	POLYURETHANE FOAM, FIRM DENSITY
6	n	2	6¼" × 3⅝"	0	5⅞	POLYURETHANE FOAM FIRM DENSITY
	-	A/R	4d NAIL			STAINLESS STEEL 18-8
	-	A/R	GLUE			WATERPROOF RESORCINAL
	h	ONE	1½" × .060" THK	1	5	CONTINUOUS HINGE STAINLESS STEEL W/ NO. 4 × ⅝" L FLAT HEAD SLOTTED BRASS
	g	2	2¾" × 1 7/16"			UTILITY DRAW PULL CATCHES BRASS PLATED
	f	ONE	1½" PROJ	0	5⅞	DRAWER PULL, CAST BRASS CHROME FINISH, W/ BRASS SCREWS
	e	2	⅜ × 5⅝	0	6¾	PLYWOOD
	d	2	⅜ × 5½	0	6¾	"
	c	4	⅜ × 5½	1	6	"
	b	ONE	⅜ × 6¼	1	5⅞	"
	a	ONE	⅜ × 6¼	1	6	PLYWOOD
ONE-TOTE BOX FOR ROCK CLASSIFIER W/ HOUSING - 1B1						

BILL OF MATERIAL

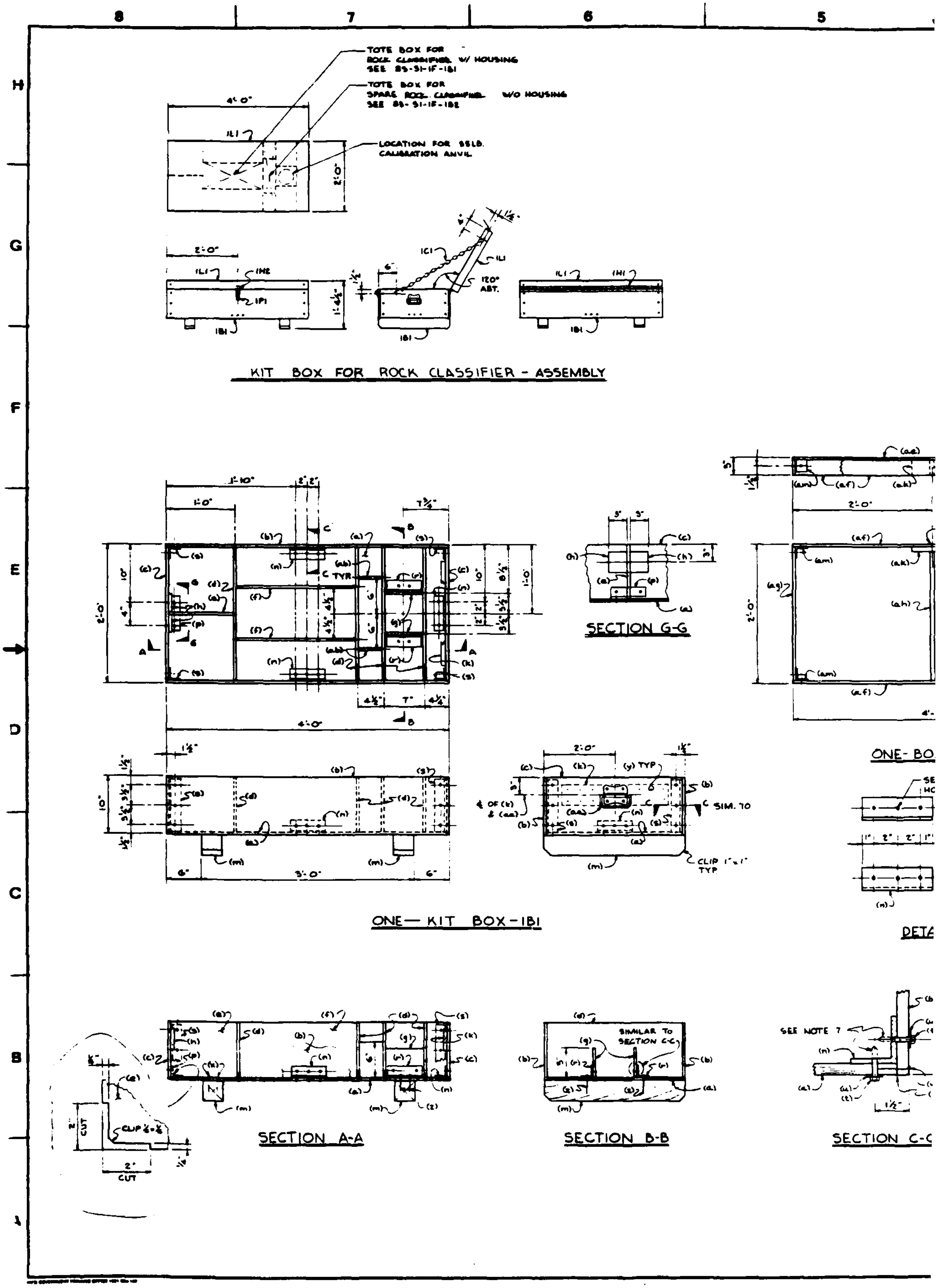
PROJ NO Y1606-01-001-A601	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NCEL DWG NO 83-31-1F	NAVAL CIVIL ENGINEERING LABORATORY PORT HUENEME, CALIFORNIA 93043
DES H. K. / DR H. KUSANO	GEOTECHNICAL TOOL SYSTEM TOTE BOXES FOR ROCK CLASSIFIER
CHK K. Maca 9-83	
SIZE F	CODE IDENT NO 80091
SCALE NONE	SHEET 1 OF 1

TOLERANCES:
FRACTIONS ±
DECIMALS ±
ANGLES ±

REV

83-31-1F

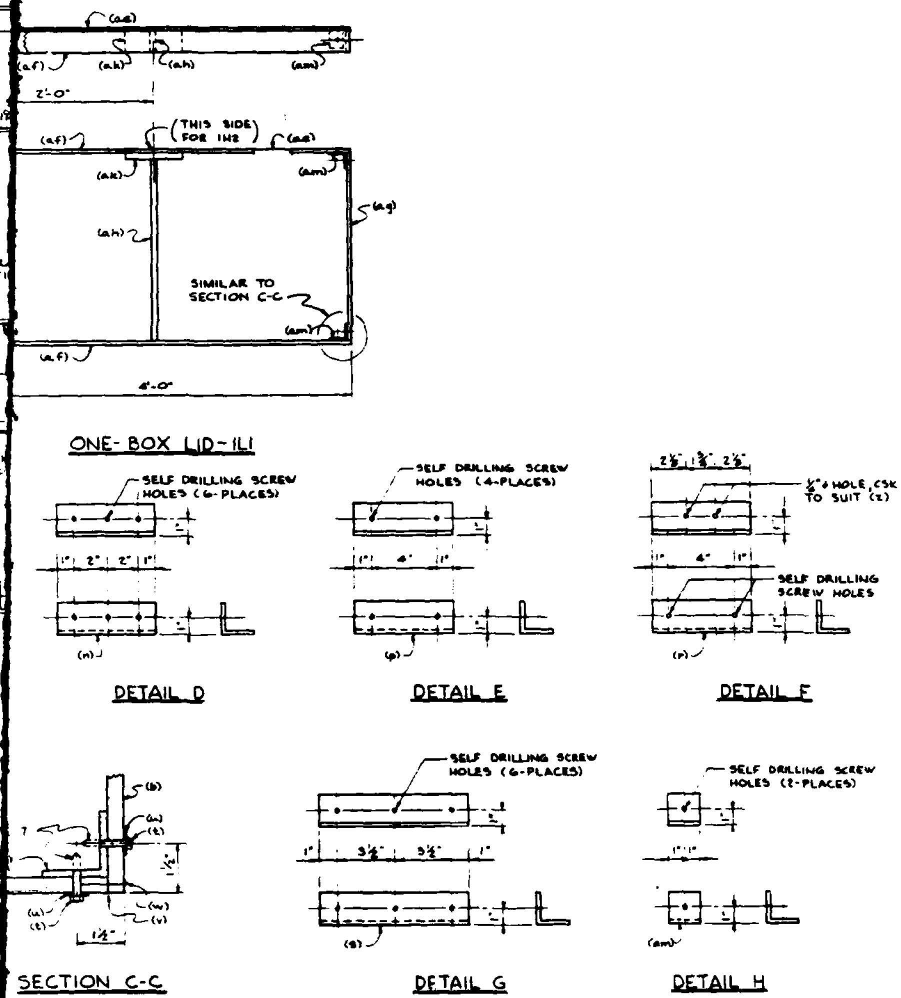
Figure 6.29. Tote boxes for rock classifier.



TOTE BOX FOR ROCK CLASSIFIER W/ HOUSING SEE 85-31-IF-181
TOTE BOX FOR SPARE ROCK CLASSIFIER W/O HOUSING SEE 85-31-IF-182
LOCATION FOR 55LB. CALIBRATION ANVIL
4'-0"
2'-0"
120° ABT.
KIT BOX FOR ROCK CLASSIFIER - ASSEMBLY
SECTION G-G
ONE- KIT BOX-1B1
CLIP 1"x1" TYP
SIM. TO
SECTION A-A
SECTION B-B
SIMILAR TO SECTION C-C
SEE NOTE 7
SECTION C-C
CLIP ⅛ x ⅛
CUT

NOTES:

1. ALL PLYWOOD SHALL BE STRUCTURAL I, C-C EXTERIOR.
2. ALL LUMBER SHALL BE STANDARD-DRESSED CONSTRUCTION GRADE, DOUGLAS FIR.
3. ALL ROUGH EDGES & CORNERS ON WOOD & ALUMINUM SHALL BE SANDED & GROUND SMOOTH, RESPECTIVELY.
4. ALL PROTRUDING WOOD SCREWS SHALL GROUND FLUSH.
5. ALL WOOD JOINTS SHALL BE GLUED & NAILED. SPACE 2d & 4d @ 2" ON CENTERS; 8d @ 2¼".
6. APPLY PLASTIC WOOD COMPOUND TO ALL PLYWOOD EDGES. PRIME & COAT ALL WOOD SURFACES & EDGES WITH EXTERIOR PAINT; FINISH COLOR TO BE GRAY.
7. ALL PROTRUDING SELF DRILLING SCREWS SHALL BE CUT & GROUND FLUSH TO ALUMINUM ANGLES, CENTER PUNCH THREADS TO LOCK.
8. AVAILABLE: McMASTER-CARR SUPPLY CO. LOS ANGELES, CA 90054



MARK	NO. REQ'D	SIZE	FT	IN	REMARKS
	4	NO. 6	0	0½	ROUND HEAD SLOTTED SCREWS STAINLESS STEEL 18-8
	2	NO. 35	2	10½	STAINLESS STEEL SASH CHAIN
2-BOX LID CHAINS-1C1 (NOT DETAILED)					
	ONE	1½"W x 1⅝"H			NO 1557A54, NOTE 8
ONE-PADLOCK-1P1 (NOT DETAILED)					
	A/R	NO 7 x ⅝"L. ON (B) NO. 7 x 1⅛"L ON (C)			WOOD SCREWS. FLAT HEAD SLOTTED BRASS
	ONE	1¾ x .030THK	0	4	CAST BRASS WITH STAPLE PLATE AND [illegible], NO. [illegible], NOTE 8
ONE-SAFETY HASP-1H2 (NOT DETAILED)					
	A/R	NO. 6	0	0½	FLAT HEAD SLOTTED, S.S. 18-8
	ONE	2" x .060"THK	4	0	STAINLESS STEEL TYPE 3022B
ONE-CONTINUOUS HINGE-1H1 (NOT DETAILED)					
y	A/R	2d NAILS			SEE 1B1 REMARKS
w	A/R	4d NAILS			↓
v	A/R	GLUE			↓
u	8	WASHERS			↓
t	8	SCREWS			SEE 1B1 REMARKS
am	4	L2 x 2 x ⅛	0	2	ALUMINUM 6061 DETAIL H
ak	ONE	1 x 2½	0	7	LUMBER
ah	ONE	1 x 2½	1	10½	LUMBER
ag	2	½ x 2½	1	11	PLYWOOD
af	2	½ x 2½	4	0	"
ae	ONE	½ x 24	4	0	PLYWOOD
ONE-BOX LID-1L1					
ab	2	½ x 4	0	6	PLYWOOD
aa	2	5¾" x 4½"			CAST BRASS CHEST HANDLE, NO. 1648A6 NOTE 8, W/ NO. 10 x 1⅛"L SCREWS, S.S. 18-8
z	4	NO. 12 (.216"φ)	0	3	FLAT HEAD SLOTTED, S.S. 18-8
y	A/R	2d NAILS			GALVANIZED STEEL
x	A/R	8d NAILS			" "
w	A/R	4d NAILS			GALVANIZED STEEL
v	A/R	GLUE			WATERPROOF RESORCINAL
u	50	¼" I.D x ¾" O.D x .06 THK			FLAT WASHERS, STAINLESS STEEL 18-8
t	50	.216"φ	0	1⅛	HEX WASHER HEAD ZINC PLATED STEEL SELF DRILLING SCREW, NO. 94055A506, NOTE 8
s	4	L2 x 2 x ¼	0	9	ALUMINUM 6061 DETAIL G
r	2	↓	0	6	↓ DETAIL F
p	ONE	↓	0	6	↓ DETAIL E
n	5	L2 x 2 x ¼	0	6	ALUMINUM 6061 DETAIL D
m	2	4 x 4	2	0	LUMBER
k	ONE	1 x 4	1	6	"
h	2	1 x 4	0	3	LUMBER
g	2	½ x 5	0	6½	PLYWOOD
f	2	½ x 9½	1	7¾	↓
e	ONE	½ x 9½	0	11¼	↓
d	4	½ x 9½	1	11	↓
c	2	½ x 10	1	11	↓
b	2	½ x 10	4	0	↓
a	ONE	½ x 25	3	11	PLYWOOD
ONE-PARTS BOX-1B1					

BILL OF MATERIAL

PROJ NO Y1606-01-001-A601
NCEL DWG NO 83-30-1F

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

GEOTECHNICAL TOOL SYSTEM
KIT BOX FOR
ROCK CLASSIFIER

SIZE F | CODE IDENT NO 80091 | SCALE NONE | SHEET 1 OF 1

TOLERANCES: FRACTIONS ± 1/16, DECIMALS ±, ANGLES ±

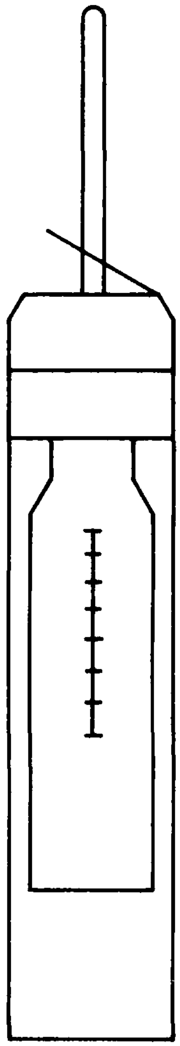
IF IN DOUBT, ASK - DO NOT SCALE!

83-30-1F

Figure 6.30. Kit box for rock classifier.

USE SOFT LEAD PENCIL ONLY

ROCK CLASSIFIER



Site & Data ID				
Serial #				
REBOUND NUMBER, R				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

NOTES:

Figure 6.31. Rock classifier diver's slate. Engrave layout onto a 9x12x1/8-inch piece of white, high impact styrene plastic, leaving a 1-inch border all around. Paint with black paint, wipe off while wet, leaving black paint in the grooves. Drill hole at top center of slate to attach line for pencil and to attach slate to diver.

CHAPTER 7

WATER PUMP

7.1 INTRODUCTION

The manufacturer's operation manual for the water pump used with the jet probe and vacuum corer is presented in this chapter as Section 7.2. The manufacturer's operation and maintenance instructions for the gasoline engine on the water pump are in Section 7.3. The manufacturer's information is provided rather than trying to rewrite it. Shipping guidelines are in Section 7.4. These guidelines present information on general shipping regulations effective in 1984 as well as on preparing the gasoline engine on the pump for shipment.

7.2 OPERATORS MANUAL

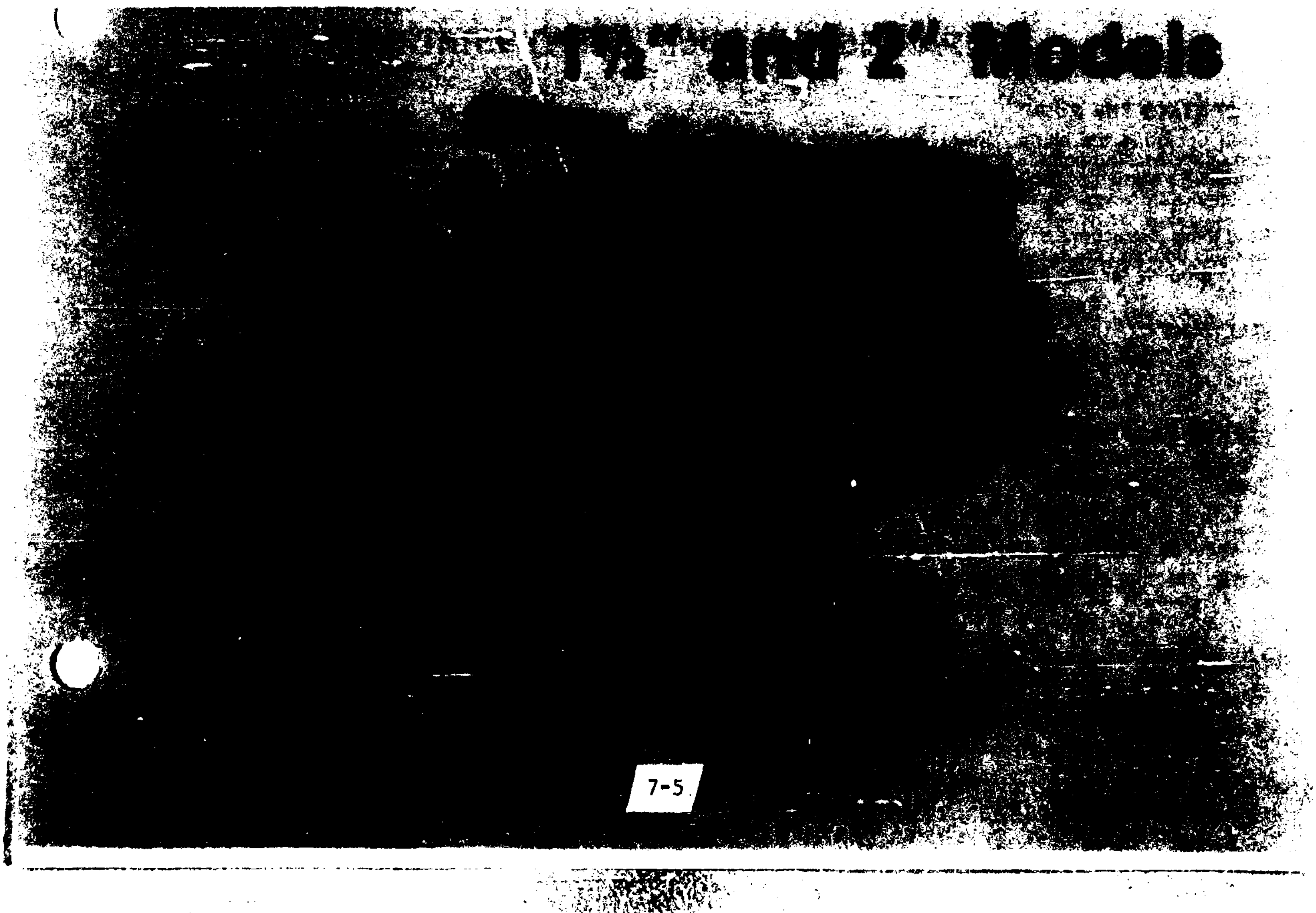
SECOND EDITION
PART NUMBER 17043-A
Printed in U.S.A.

OPERATORS MANUAL

CORROSION RESISTANT
LIGHTWEIGHT
HIGH LIFT
FAST PRIME
HIGH VOLUME

4-CYCLE ENGINE-DRIVEN PORTABLE PUMPS

MANUAL SUPPLIED FREE TO PURCHASER OF PUMP • EXTRA COPIES 35¢ EACH



SAFETY PRECAUTIONS

WARNING

1. This pump is designed for pumping water and general farm liquid fertilizers, herbicides and pesticides. Flammable materials such as gasoline should not be pumped with this pump. Explosion might result, causing serious injury. Corrosive materials should be handled with caution, taking into consideration the handling instruction for the particular material.
2. Before starting the pump, study all of the instructions in this booklet and the Engine Operating and Maintenance Instructions supplied with the unit. Make sure you thoroughly understand how to operate the machine. Proper preparation, operation and maintenance will result in operator safety, optimum performance and long unit life.
3. Be sure each person who operates the machine is properly instructed in its safe operation.
4. Never operate the machine in an explosive atmosphere, near combustible materials or where ventilation is not sufficient to carry away exhaust fumes.
5. Always be sure that the machine is on secure footing so that it cannot slide or shift around, endangering workers.
6. Keep the immediate area free of all bystanders.
7. When starting the machine, be sure that nothing is in a position to be hit by the operator's hand or arm, or the starting rope.
8. Never operate this machine with any guard removed.
9. Observe all safety regulations for the safe handling of fuel in safety containers. If container does not have a spout, use a funnel. Do not refill engine while it is running or hot. Fill the tank only on an area of bare ground. While filling the tank, keep heat, sparks and open flame away. Carefully clean up any spilled fuel before starting engine.
10. Avoid contacting the hot exhaust manifold, muffler or cylinder. Keep clear of all rotating parts.
11. Always keep the machine and all associated equipment clean, properly serviced and maintained.
12. Before working on any part of the machine, shut off the engine and disconnect the spark plug wire to prevent accidental starting.
13. Never run pump in an enclosed area.

PREPARING THE PUMP FOR OPERATION

UNCRATING THE PUMP

When uncrating the pump, loosen any shipping blocks, clamps and packing material from the unit. Look the unit over carefully for shipping damage. If you find any damage, report it immediately to your dealer or the shipper.

Read these instructions and the 4-cycle engine instructions carefully until you are sure you can prepare the engine and pump properly for use, and can operate it safely and correctly.

WARRANTY

The pump is warranted for the period and under the conditions stated on the warranty card packaged with the pump. Fill out the card and mail it.

ENGINE PREPARATION

The engine is a 4-cycle, 3-horsepower, Briggs & Stratton no. 80232 (Homelite part no. A-54965-AS). It is lubricated by engine oil in the crankcase. The engine is governed to operate at speeds close to 3600 rpm and the governor setting *must not be changed* by the operator or owner.

NOTE: The fuel for this 4-cycle engine is regular grade gasoline 87 Octane (average) minimum. No oil should be mixed with the gasoline. However, engine lubricating oil in the crankcase should be checked before use. Follow instructions in the Briggs & Stratton instruction manual in all matters of 4-cycle engine preparation, engine oil selection, operation, maintenance and trouble-shooting.

Do not leave gasoline in the engine tank for long periods of time because gasoline breaks down as it ages. The peroxides and gums in old stale gasoline can attack the interior surfaces of the fuel system and engine, clog the carburetor, and prevent starting. The "freshness" of fresh gasoline can be prolonged for several months by treating the newly purchased gasoline with an anti-oxidant type of fuel stabilizer (such as STA-BIL®, available from Knox Laboratories, Chicago, Illinois 60616) according to instructions on the stabilizer can.

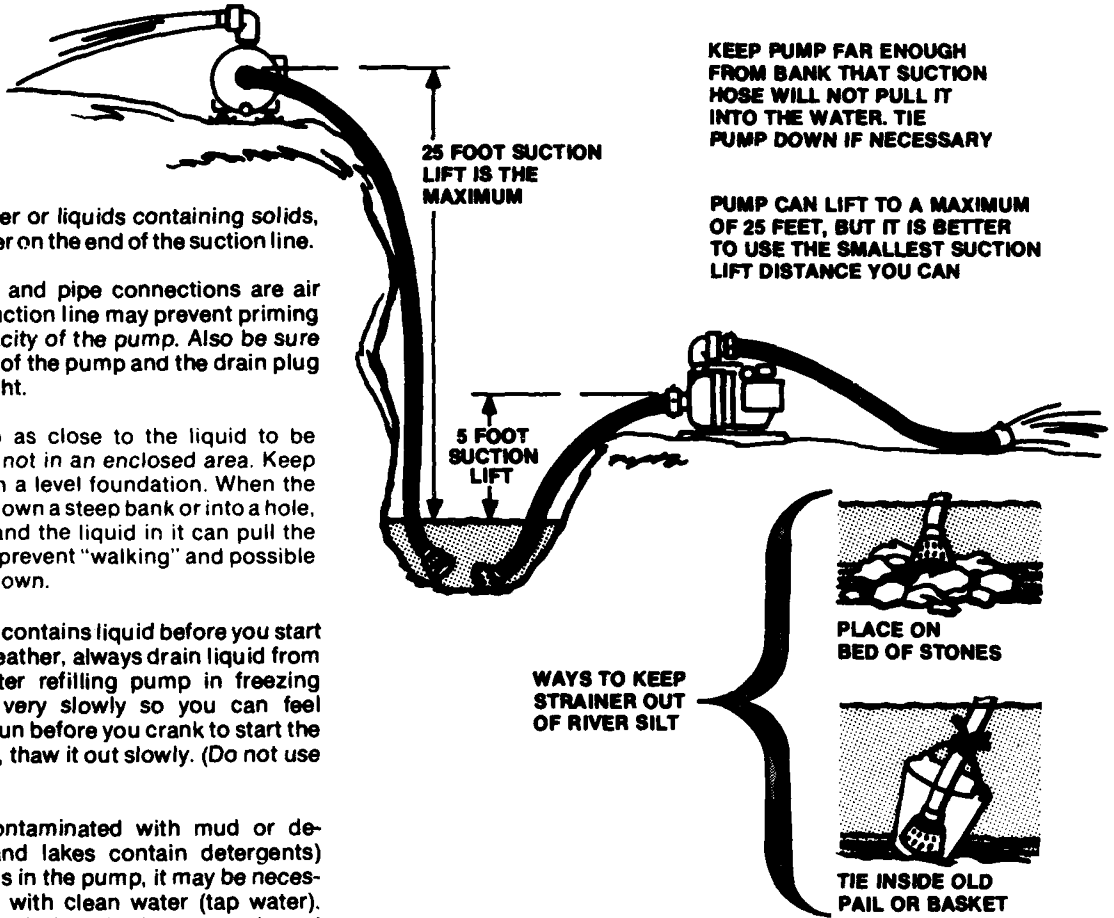
PUMP PREPARATION

CAUTION: Do not run the pump dry. There must be liquid in the pump to lubricate the pump shaft seal.

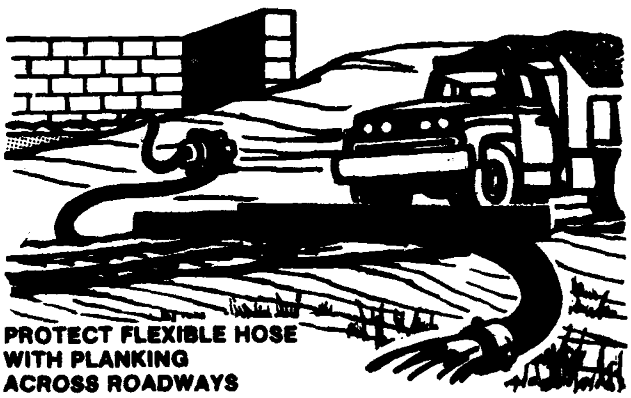
Always fill the pump body with water (or the liquid to be pumped) before starting the pump. It is not necessary to drain the pump body after use, unless there is a danger of freezing.

The pump shaft seal is lubricated by the liquid being pumped. The seal is designed to handle clean or dirty liquids. No other points on the pump require lubrication.

OPERATING INSTRUCTIONS



1. When pumping dirty water or liquids containing solids, always use a pump strainer on the end of the suction line.
2. Make sure that all hose and pipe connections are air tight. An air leak in the suction line may prevent priming and will reduce the capacity of the pump. Also be sure that the filler plug on top of the pump and the drain plug at bottom rear are air tight.
3. Always place the pump as close to the liquid to be pumped as possible but not in an enclosed area. Keep the pump and engine on a level foundation. When the suction hose is hanging down a steep bank or into a hole, the weight of the hose and the liquid in it can pull the pump into the liquid. To prevent "walking" and possible loss of the pump, tie it down.
4. Always be sure the pump contains liquid before you start the engine. In freezing weather, always drain liquid from the pump after use. After refilling pump in freezing weather, crank engine very slowly so you can feel whether pump is free to run before you crank to start the engine. If pump is frozen, thaw it out slowly. (Do not use fire to thaw pump).
5. If pumping liquid is contaminated with mud or detergents (many rivers and lakes contain detergents) which will churn into suds in the pump, it may be necessary to prime the pump with clean water (tap water). Once primed, the pump will handle the contaminated liquid.
6. Maximum volume is achieved by:
   (a) Keeping lines as straight as possible, and avoiding kinks and sharp bends in the hoses.
   (b) Making the vertical suction lift distance as short as possible (see illustration).
   (c) Using large diameter suction and discharge lines (The larger the diameter the lower the friction).
   (d) Using as few connectors, elbows and adapters as you can get away with
   (e) Maintaining the pump and associated equipment in good operable condition.
7. If flexible hose must be laid across a roadway, protect it with planking. Instantaneous shut-off pressures, applied when a vehicle runs across an unprotected hose, will cause pounding. Pounding can split the pump body or damage the hose.



NOTE: ALL CONNECTIONS ON SUCTION SIDE OF PUMP MUST BE AIR TIGHT.

8. When the suction strainer is likely to clog with muck and roots, prepare a bed of stones on which to rest the strainer; or tie the strainer so that it stays off the bottom; or tie it in a basket or pail (see illustration).
9. When pumping liquids (such as Liquid Fertilizer) containing solids, the time required to prime will increase and the pumping volume (gallons per minute) will decrease as the proportion of solid matter in the liquid to be pumped is increased. The viscosity or thickness of the liquid also will affect the priming time and the pumping volume. Any consistency of liquid which increases friction and drag in the pump and lines will retard the output.
10. The rubber molded check valve in the "chimney" of the pump volute will seal off the pump to retain liquid in the suction line so that the pump will start pumping immediately after short periods of shut-down.
11. When the pump is used only now and then, it is a good idea to check that the unit is ready for operation by (a) checking the level of oil in the engine crankcase and (b) filling the pump with liquid.
12. The pump as supplied will effectively pump 90%-95% of the agricultural chemicals on the market today. For pumping herbicides such as Monsanto's *Lasso*® or Elanco's *Treflan*® the EPDM or BUNA-N Kit must be installed.The EPDM Kit is supplied on the AP220 & 215 & 520-1.The BUNA-N Kit is supplied on the AP315 & AP320.

ENGINE MAINTENANCE AND UNIT STORAGE

1. Follow instructions in the Briggs & Stratton Instruction Manual in all matters of engine maintenance. The air filter must be cleaned regularly, the proper level of oil maintained in the crankcase, and the engine oil must be changed at regular intervals.

2. After every 100 hours of operation, the cylinder head should be removed and the engine deposits removed carefully from the combustion chamber and the top of the piston. We recommend that engine work such as carbon removal be done by a Briggs & Stratton or Homelite Construction Equipment Service Station. The engine can be inspected, repaired if necessary, and tuned for optimum performance at this time.

3. When the engine is to be idle for a long period of time, both pump and engine should be prepared for storage as given below:

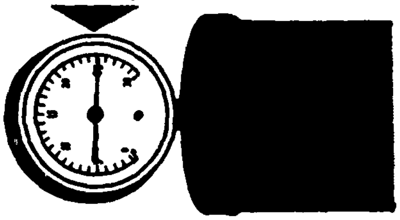
(a) If the engine tank contains anti-oxidant-treated gasoline you may store the pump for as long as two months with the tank filled to the top. If the gasoline is untreated, drain the tank and use up your reserve fuel supply in another engine. Start and run the pump engine until it dies from lack of fuel.

(b) Drain the pump. If the pump contains liquids which could dry out and cake up, it is a good idea to pump a little clear water before draining the pump.

(c) Leave the filler and drain plugs out of the pump.

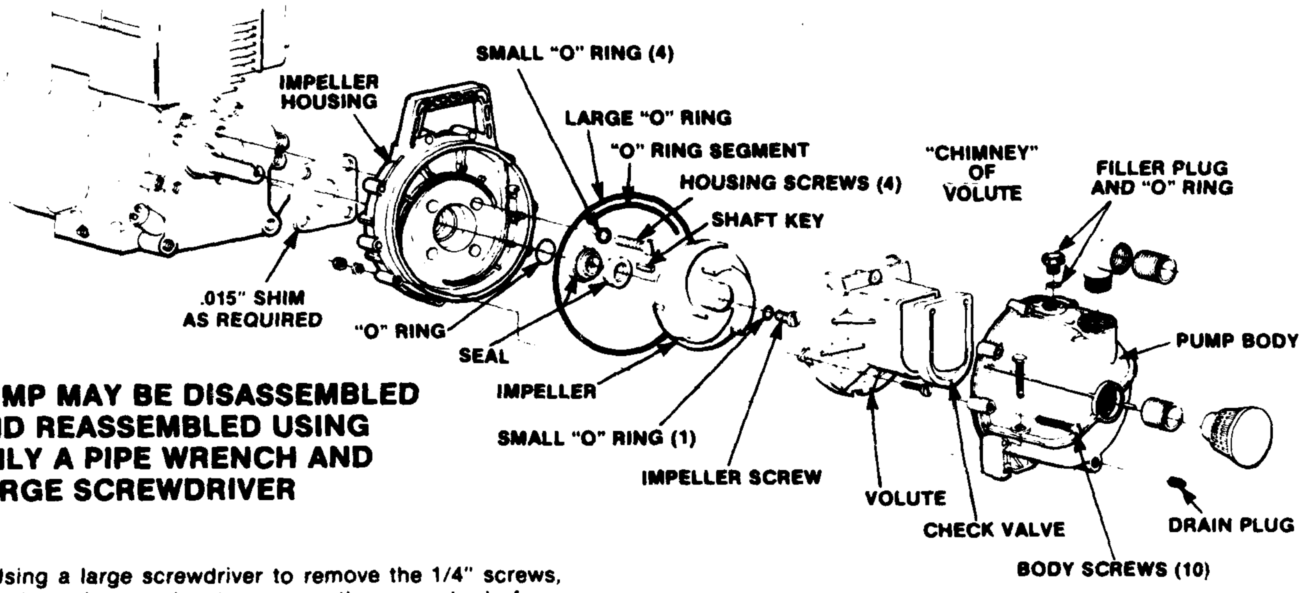
(d) Wipe down the exterior of the unit. It must be stored in a dry, well ventilated area, away from fertilizers and corrosive salts. Try to keep the unit in a cold or cool area where the temperature changes very little. Dampness and heat will accelerate rust of the engine parts, so cold, dry area storage is your best bet for long engine life.

PUMP TROUBLE-SHOOTING AND REPAIR

DIAGNOSIS	TREATMENT
1. DOES NOT PRIME OR DOES NOT PUMP	• Fill pump with clean liquid and try priming again.
25 INCHES (MAX.) 	• Disconnect suction and discharge lines at pump. Check pump suction by holding palm of hand over suction opening (or use a vacuum gauge). Maximum vacuum should be about 25 inches on vacuum gauge). You can live with less vacuum as long as satisfied with lower performance. If dissatisfied, disassemble and check the impeller, wear plate and seal.
	• If pump suction tests O.K., attach suction line and check suction at end of suction line. Failure to get suction here indicates leaking connections or leaking or collapsing lines. Liners of damaged suction hose will often be sucked shut inside the hose.
	• If good intake suction, put on the discharge line. The only thing which could interfere with pumping here would be a blockage.
2. OUTPUT O.K. AT LOW LIFTS, BUT FALLS OFF AT MEDIUM HEIGHT SUCTION LIFTS.	• Worn pump can handle low lifts. Lower the lift distance, if possible, or check pump out as below.
	• Body screws have loosened to permit an interior air leak. Recheck after tightening.
	• Worn or damaged pump parts. Disassemble. Check rubber wear plate, impeller volute and shaft seal. Replace any broken or worn components; check clearance between impeller blades and wear plate. Reassemble using all new "O" rings. Shim to .015" impeller to volute clearance during reassembly.

NOTE: Failure of pump to perform satisfactorily, i.e. pump heavy liquids or negotiate high lifts up to its expected ability, may not be the pump's fault. If you find nothing wrong with the pump, have the engine inspected, overhauled if necessary, and tuned for the altitude range you expect to use the pump.

HOW TO DISASSEMBLE AND REPAIR THE PUMP



PUMP MAY BE DISASSEMBLED AND REASSEMBLED USING ONLY A PIPE WRENCH AND LARGE SCREWDRIVER

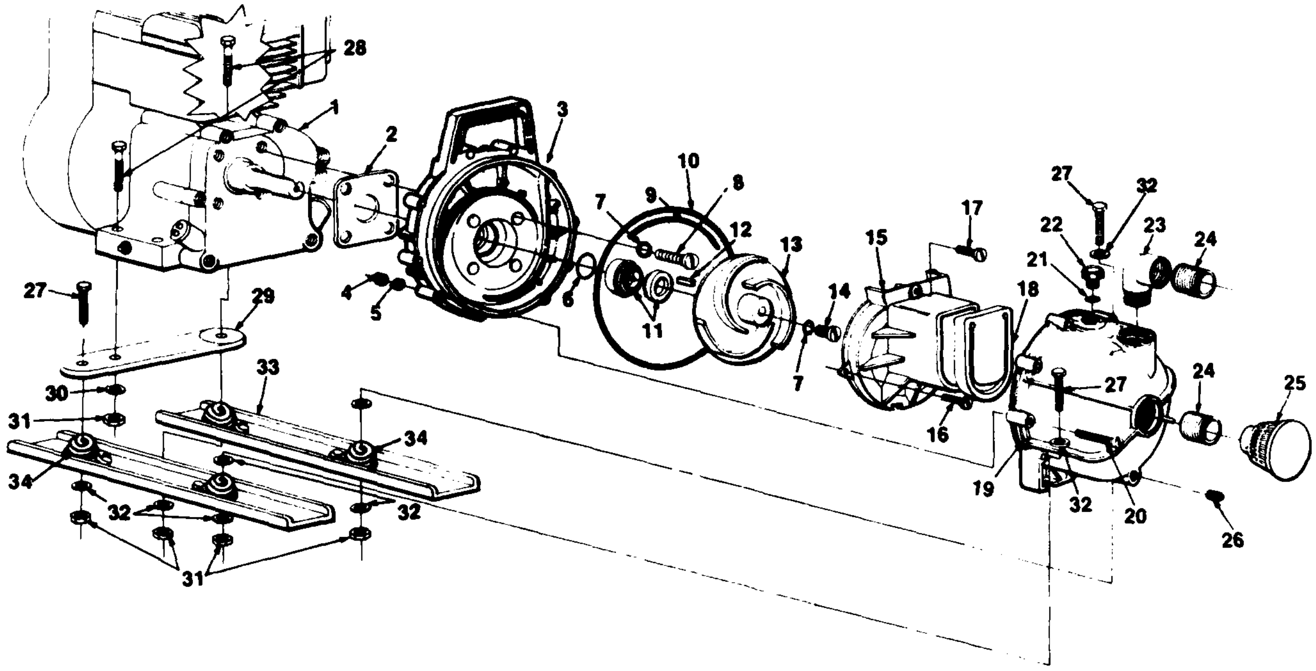
1. Using a large screwdriver to remove the 1/4" screws, lock washers and nuts, remove the pump body from the impeller housing.
2. Remove the rubber check valve from the "chimney" of the volute.
3. Remove the large self-tapping screw at the top of the volute and the two smaller self-tapping screws at the sides of the volute.
4. Unscrew the 5/16-24 x 3/4 (fine thread) impeller screw and remove it along with the small "O" ring. Slide the impeller off the shaft and key.
5. One half of the shaft seal is in the impeller hub, the other half is on the shaft inside the back plate. Remove both halves.
6. Remove the four steel screws (and small "O" rings) and pull the impeller housing off the engine.
7. See that the key fits the shaft groove snuggly. If it doesn't, replace the key with a wider one.
8. The clearance between the impeller blades and the volute must be about .015" for good pumping. If the impeller blades and volute are worn, there may be too much "front" clearance. You can reduce the clearance by taking out one or all of the .015" thickness shims between the impeller housing and the engine. After locking the impeller back in place temporarily and check the impeller blade-to-volute clearance with a feeler gauge. Continue (below) with reassembly.

CAUTION: When reassembling pump, (as in steps 10 through 15) after adjustment of the clearance (as above) you must check that there is no contact between the volute and impeller. Rotate shaft slowly by hand and listen for scraping noises. If you hear no noises, put priming liquid into the pump and start up the engine. If there is no scraping noise, your assembly is probably O.K.

9. If you cannot get a clearance reasonably close to .015" between the impeller and wear plate, install new parts as required.
10. During final assembly, be sure to change all of "O" ring seals unless you are positive they are in good condition.
11. Put all of the parts back together in the reverse of the order used in disassembly.

WARNING: Do not use any petroleum oil or grease in the assembly and do not pump petroleum products with this pump.

12. When assembling nipples, fittings, and elbows into the pump body, wrap the male threads with Teflon® sealing tape. This tape gives a more superior seal than pipe joint compound without making the connections so tight as to damage the threads. The proper tightness is *hand tight plus one full turn with a pipe wrench.* (No tighter than that, please.)
13. The four 5/16"-24 x 1-1/8" screws (with an "O" ring on each) holding impeller housing to engine should be tightened securely with a large screwdriver. When your rebuilding is completed, fill the pump with liquid and test whether its full capacity has been restored.
14. The screws holding the volute in place do not have to be tightened any more than needed to secure the volute during assembly. Overtightening may cut the "O" rings. The impeller and the outside body screws should be made moderately tight to insure against air leaks.



REPLACEMENT PARTS & ACCESSORY KITS FOR AP SERIES PUMPS

KEY NO.	DESCRIPTION	PART NO.	QTY.	AP215-1	AP215-1A	AP220-1	AP220-1A	AP315-1	AP315-1A	AP320-1	AP320-1A	AP520-1
1	ENGINE	A-54965-AS	1	x	x	x	x	x	x	x	x	
	ENGINE	A-48469-S	1									x
2	SHIM	43269	A/R	x	x	x	x	x	x	x	x	x
	SHIM (.010)	42382	A/R	x	x	x	x	x	x	x	x	x
	SHIM (.015)	42383	A/R	x	x	x	x	x	x	x	x	x
3	HOUSING- Impeller	43270-B	1	x	x	x	x	x	x	x	x	x
4	NUT- Hex 1/4-20	81172	10	x	x	x	x	x	x	x	x	x
5	WASHER- Lock 1/4	83051	10	x	x	x	x	x	x	x	x	x
6	"O" RING (Buna N)	43751	1	x	0	x	0		x		x	0
	"O" RING (EPDM)	43752	1		x		x	‡	‡	‡	‡	x
7	"O" RING, Screw (Buna N)	67900	5	x	0	x	0	x	x	x	x	0
	"O" RING, Screw (EPDM)	43313	5	‡	x	‡	x	‡	‡	‡	‡	x
8	SCREW, Bracket, impeller hsg.	43302	4	x	x	x	x	x	x	x	x	x
9	"O" RING, Segment (Buna N)	43272	1	x	0	x	0	x	x	x	x	0
	"O" RING, Segment (EDPM)	43314	1	‡	x	‡	x	‡	‡	‡	‡	x
10	"O" RING, Body (Buna N)	43273	1	x	0	x	0	x	x	x	x	0
	"O" RING, Body (EPDM)	43312	1	‡	x	‡	x	‡	‡	‡	‡	x
11	SHAFT SEAL (Buna N)	43271	1	x	0	x	0	x	x	x	x	0
	SHAFT SEAL (EPDM)	43303-A	1	‡	x	‡	x	‡	‡	‡	‡	x
12	KEY, 3/16 x 3/16 x 1	43301-A	1	x	x	x	x	x	x	x	x	x
13	IMPELLER	43274-A	1	x	x	x	x	x	x	x	x	x
14	SCREW, Impeller, rd. hd. 5/16-24 x 3/4	43284	1	x	x	x	x	x	x	x	x	x
15	VOLUTE	43324-A	1	x	x	x	x	□	□	□	□	x
	VOLUTE (rubber faced)	A-43275	1					x	x	x	x	
16	SCREW- Volute (stainless) 6-32 x 1/2 rd. hd.	43285-A	2	x	x	x	x	x	x	x	x	x
17	SCREW- Volute top (10-24 x 1 1/2) rd. hd.	46044	1	x	x	x	x	x	x	x	x	x
18	CHECK VALVE (Buna N)	43276-A	1	x	0	x	0	x	x	x	x	0
	CHECK VALVE (EPDM)	43300-A	1	‡	x	‡	x	‡	‡	‡	‡	x
19	BODY 1 1/2"	43277-A	1	x	x			x	x			
	BODY 2"	43278-A	1			x	x			x	x	x
20	SCREWS- Body fil. (1/4-20 x 2 1/2)	46045	10	x	x	x	x	x	x	x	x	x
21	"O" RING- Fil. plug (Buna N)	43316	1	x	0	x	0	x	x	x	x	0
	"O" RING- Fil. plug (EPDM)	43315	1	‡	x	‡	x	‡	‡	‡	‡	x
22	PLUG- Filler	43311-A	1	x	x	x	x	x	x	x	x	x

NO.	DESCRIPTION	PART NO.	QTY.	AP215-1	AP215-1A	AP220-1	AP220-1A	AP315-1	AP315-1A	AP320-1	AP320-1A	AP520-1
23	ELBOW- Street, 1 1/2"	43304	1	□	□			x	x			
	ELBOW- Street, 2"	43305	1			□	□			x	x	□
24	PIPE, Fitting, 1 1/2	75959-1	2	□	□			x	x			
	PIPE, Fitting, 2"	75663-1	2			□	□			x	x	□
25	STRAINER, 1 1/2"	43306	1	□	□			x	x			
	STRAINER, 2"	43307	1			□	□			x	x	□
26	PLUG- Drain	46317-A	1	x	x	x	x	x	x	x	x	x
27	SCREW- Hex 5/16-18 x 1	46053	3	†	†	†	†	x	x	x	x	†
28	SCREW- Engine mtg. 5/16-18 x 1 1/2	46060	2	†	†	†	†	x	x	x	x	†
29	BAR- Mounting	43262-1	1	†	†	†	†	x	x	x	x	†
30	WASHER- Lock 5/16 heavy	83003	1	†	†	†	†	x	x	x	x	†
31	NUT- Hex hd., 5/16-18	81132	5	†	†	†	†	x	x	x	x	†
32	WASHER- Flat, 5/16	84032	8	†	†	†	†	x	x	x	x	†
33	SKID	A-43263	2	†	†	†	†	x	x	x	x	†
34	Includes: SPRING- Foot	50389	4	†	†	†	†	x	x	x	x	†
	RIVET (not shown)	85025	4	†	†	†	†	x	x	x	x	x
	LABEL- Warning (not shown)	43265	1		x		x		x		x	x
	DECAL (Homelite) (not shown)	47833	1		x		x		x		x	x
	DECAL- EPDM (not shown)	43880-A	1		x		x	‡	‡	‡	‡	x
	DECAL- BUNA-N	48328	1		0		0		x		x	0
	DECAL- Instruction (not shown)	53876-A	1		x		x		x		x	x
	DECAL (AP215-1A) (not shown)	47834	1		x							
	DECAL (AP220-1A) (not shown)	47835	1				x					
	DECAL (AP315-1A) (not shown)	48836	1						x			
	DECAL (AP320-1A) (not shown)	47837	1								x	
	DECAL (AP520-1) (not shown)	48468	1									x

x Standard equipment on these models
† Found in accessories Skid Kit A-43318
‡ Found in optional EPDM Repair Kit A-43297-B (see note)
□ Optional equipment on these models
0 Found in Buna-N Repair Kit A-47832

ACCESSORIES:

ACCESSORIES	PART NO.	AP215-1	AP215-1A	AP220-1	AP220-1A	AP315-1	AP315-1A	AP320-1	AP320-1A	AP520-1
EPDM Repair Kit (See Note)	A-43297-B	□	□	□	□	□	□	□	□	□
Skid Kit	A-43318	□	□	□	□	x	x	x	x	□
Rubber Feet Kit	A-43299	□	□	□	□	□	□	□	□	□
Viton Repair Kit (opt.)	A-48298	□	□	□	□	□	□	□	□	□
Buna-N Repair Kit	A-47832	□	□	□	□	x	x	x	x	□
FITTING- Garden hose	48512		□		□		□		□	□
CAP- Hose	48515		□		□		□		□	□

NOTE: When using EPDM Kit or Viton Kit on AP315, AP320 & AP520, you must change Volute to number 43324-A.

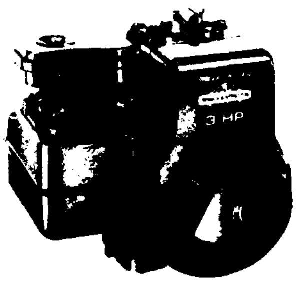
2382JY

HOMELITE
CONSTRUCTION & INDUSTRIAL EQUIPMENT
14401 Carowinds Blvd. • P.O. Box 7047 • Charlotte, North Carolina 28217

HOMELITE TEXTRON

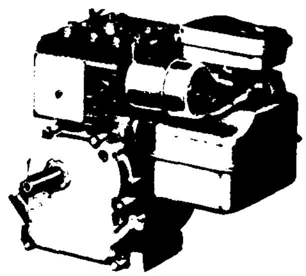
Homelite Division of Textron Inc.

7.3 OPERATING AND MAINTENANCE INSTRUCTIONS



Briggs & Stratton OPERATING AND MAINTENANCE INSTRUCTIONS MODEL SERIES

80200 to 82200



IN THE INTEREST OF SAFETY

DANGER: DO NOT RUN THE ENGINE IN AN ENCLOSED AREA. Exhaust gases contain carbon monoxide, an odorless and deadly poison.

A FIRE OR EXPLOSION CAN OCCUR RESULTING IN PERSONAL INJURY IF THE FOLLOWING INSTRUCTIONS ARE NOT FOLLOWED:

1. DO NOT FILL GASOLINE TANK while engine is running. Refuel, ONLY, after engine has cooled down.
2. Do not operate the engine when an odor of gasoline is present or other explosive conditions exist.
3. If gasoline is spilled, move machine away from the area of the spill and avoid creating any source of ignition until the gasoline has evaporated.
4. DO NOT STORE, SPILL OR USE GASOLINE NEAR AN OPEN FLAME, or devices such as a stove, furnace, water heater which utilize a pilot light, or devices which can create a spark.
5. Refuel outdoors preferably, or only in well ventilated areas.
6. DO NOT OPERATE ENGINE WITHOUT A MUFFLER, inspect periodically and replace, if necessary.
7. Periodically clean the muffler area to prevent grass, dirt and combustible material from accumulating.
8. DO NOT use this engine on any forest covered, brush covered or grass covered unimproved land unless a spark arrester is attached to the muffler.
9. Except for adjustment, DO NOT operate the engine if air cleaner or cover directly over the carburetor air intake is removed.
10. DO NOT choke carburetor to stop engine.

WARNING: DO NOT RUN ENGINE AT EXCESSIVE SPEEDS. Operating an engine at excessive speeds increases the danger of personal injury. DO NOT TAMPER WITH GOVERNOR SPRINGS, GOVERNOR LINKS OR OTHER PARTS WHICH MAY INCREASE THE GOVERNED ENGINE SPEED

A.N.S.I. Standard Safety Specifications for rotary power lawn mowers specify a maximum blade tip speed of 19,000 feet per minute (96.5 meters per second), primarily to reduce the danger from thrown objects.

Do not tamper with the engine speed selected by the original equipment manufacturer.

DO NOT TOUCH hot mufflers, cylinders or fins as contact may cause burns.

Dirt and grass clippings or other debris, in cooling fins or governor parts can affect engine speed. See cleaning instructions in MAINTENANCE section.

TO PREVENT HAND OR ARM INJURY, always pull starter cord rapidly to avoid kickback; starting engine with a loose blade or without a blade may cause a severe kickback.

ALWAYS KEEP HANDS AND FEET CLEAR OF MOVING OR ROTATING PARTS

TO PREVENT ACCIDENTAL STARTING when servicing the engine or equipment, always remove the spark plug or wire from the spark plug and insert in holding tab shown on page 2.

WHEN WORKING ON EQUIPMENT

DO NOT STRIKE FLYWHEEL with a hard object or metal tool as this may cause flywheel to shatter in operation, causing personal injury or property damage. To remove flywheel, use Briggs & Stratton approved tools only.

IN THE INTEREST OF ENVIRONMENT

A muffler which leaks because of rust or damage can permit an increased exhaust noise level. Therefore, examine the muffler periodically to be sure it is functioning effectively. To purchase a new muffler, see SERVICE AND REPAIR INFORMATION.

WARNING: If this engine is not equipped with a spark arrester and is to be used on any forest covered, brush covered, or grass covered unimproved land, before using on such land a spark arrester must be added to the muffler. The arrester must be maintained in effective working order by the operator. In the State of California the above is required by law (Section 4442 of the California Public Resources Code). Other states may have similar laws. Federal laws apply on federal lands. See your Authorized Briggs & Stratton Service Center for spark arrester muffler options.

SERVICE & REPAIR INFORMATION

If service or repair is needed, contact an Authorized Briggs & Stratton Service Center. To serve you promptly and efficiently, the Service Center will need the model, type and code number on your engine.

Each Authorized Service Center carries a stock of original Briggs & Stratton repair parts and is equipped with special service tools. Trained mechanics assure expert repair service on all Briggs & Stratton engines.

Major engine repairs should not be attempted unless you have the proper tools and a thorough knowledge of internal combustion engine repair procedure.

Your nearest service center is listed in the "Yellow Pages" under "Engines, Gasoline" or "Gasoline Engines". He is one of over 25,000 authorized dealers available to serve you.

This illustrated book includes "Theories of Operation", common specifications and detailed information covering the adjustment, tune-up and repair procedures for 2 through 16 H.P. single cylinder, 4 cycle models. It is available from any Authorized Briggs & Stratton Service Center. Order as Part Number 270962

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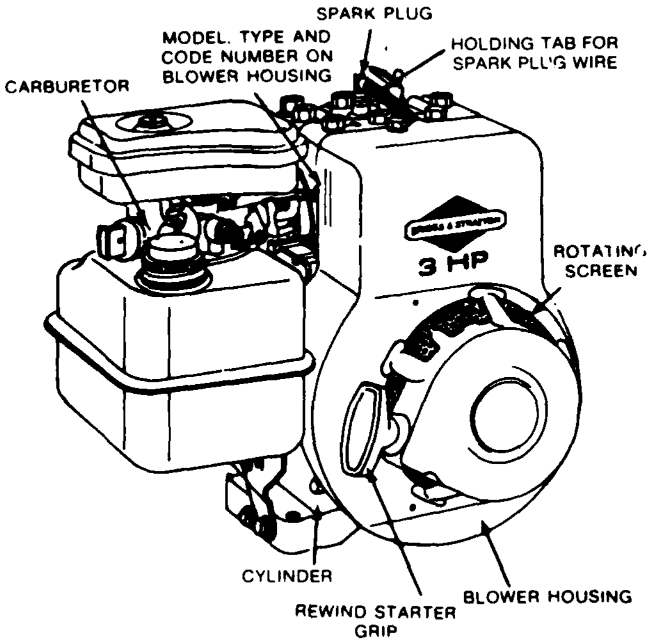
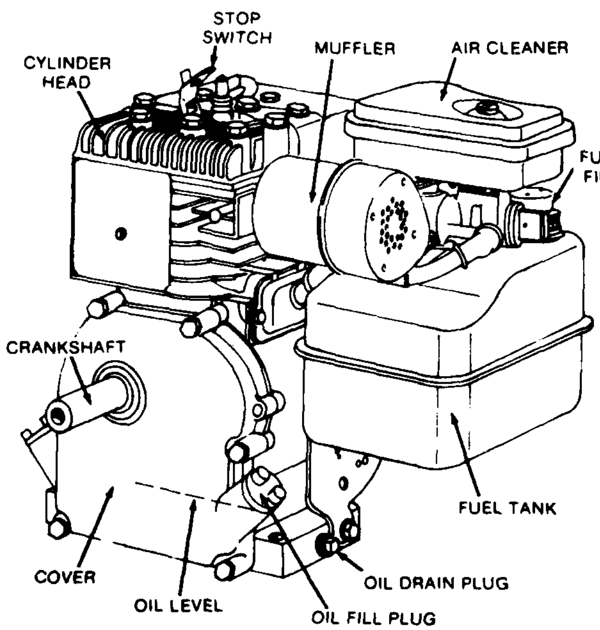
BRIGGS & STRATTON CORP.
Milwaukee, Wisconsin 53201



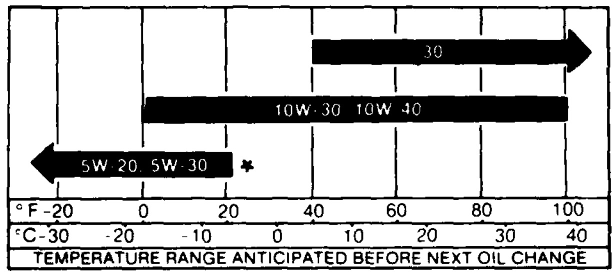


BEFORE STARTING

READ THE OPERATING INSTRUCTIONS OF THE EQUIPMENT THIS ENGINE POWERS

Use a high quality detergent oil classified "For Service SF, SE, SD or SC." Detergent oils keep the engine cleaner and retard the formation of gum and varnish deposits. Nothing should be added to the recommended oil.

RECOMMENDED SAE VISCOSITY GRADES

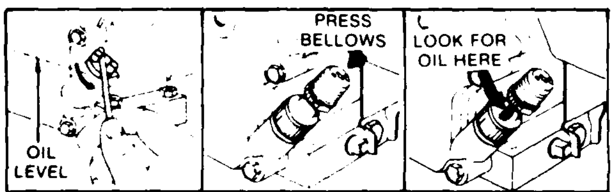


*If not available, a synthetic oil may be used having 5W-20, 5W-30 or 5W-40 viscosity.

TO FILL CRANKCASE WITH OIL

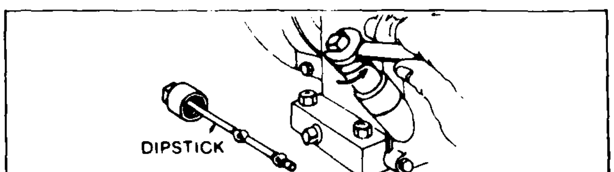
Place engine level. Clean area around oil fill before removing oil fill plug or oil minder.

OIL FILL PLUG. Remove oil fill plug or (optional) oil-minder. Fill crankcase to point of overflowing. POUR SLOWLY. Capacity approximately 1¼ pints (0.6 liters). Replace oil fill plug or oil-minder.



OIL FILL PLUG | **OIL-MINDER**

EXTENDED OIL FILL (Optional). Remove cap and dipstick. **FILL TO FULL MARK** on dipstick. POUR SLOWLY. Capacity approximately 1¼ pints (0.6 liters). When checking oil level, screw dipstick assembly firmly but slowly until cap bottoms on tube. **DO NOT OVERFILL.** Dipstick assembly must be securely assembled to tube at all times when engine is operating.



EXTENDED OIL FILL

FUEL RECOMMENDATIONS

Our engines will operate satisfactorily on any gasoline intended for automotive use. DO NOT MIX OIL WITH GASOLINE.

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We recommend the use of clean, fresh gasoline with a minimum rating of 77 Octane. Lead-free, low-lead or regular grade leaded gasolines are acceptable. The use of lead-free gasoline results in fewer combustion deposits.

DO NOT fill fuel tank to point of overflowing. Provide approximately 1/4" of tank space for fuel expansion.

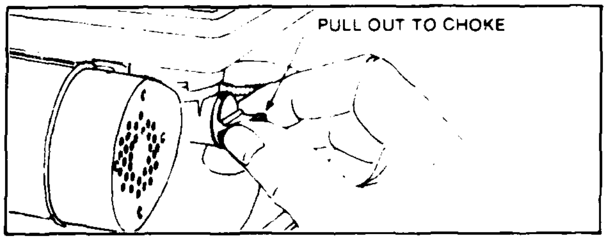
STARTING

Start, store and fuel engine in a level position.

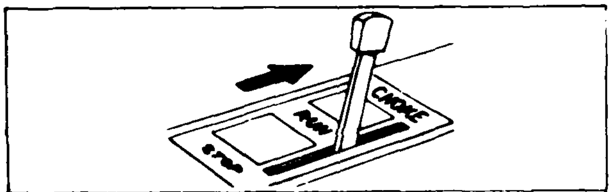
CHOKE ENGINE

Engine may be equipped with either manual, remote or *choke-a-matic controls.*

MANUAL CHOKE: Move lever as illustrated.

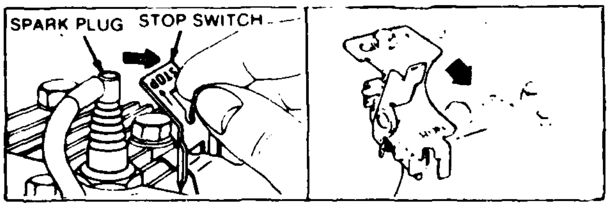


CHOKE-A-MATIC CONTROLS: Move controls as far as possible toward "CHOKE" or "START."



TYPICAL CONTROL

STOP SWITCH: Move STOP switch away from spark plug or to "RUN" position as illustrated, if so equipped.



NOTE: A warm engine requires less choking than a cold engine.

NOTE: Engine may not start if controls on powered equipment do not close choke fully. See ADJUSTMENT section.

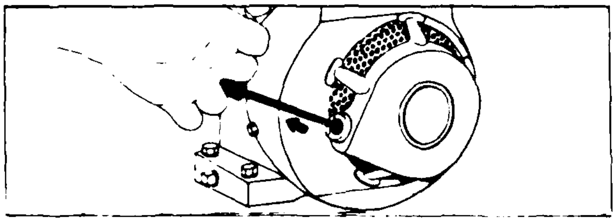
SPEED CONTROL LEVER: Move speed control lever to "RUN," "FAST" or "START" position if so equipped.

TYPICAL SPEED CONTROLS

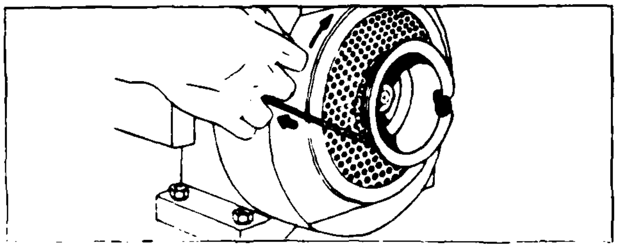
TO START ENGINE

DANGER: ALWAYS KEEP HANDS AND FEET CLEAR OF MOWER BLADE OR OTHER ROTATING MACHINERY.

Rewind Starter. Grasp starter grip as illustrated and pull out cord rapidly to overcome compression and prevent kick-back. Repeat if necessary with choke opened slightly. When engine starts, open choke gradually.



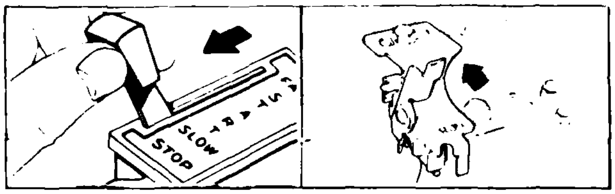
Rope Starter. Wind the starter rope around the pulley in direction shown by arrow. Pull the rope with a quick full arm stroke to overcome compression and prevent kickback. Repeat if necessary with choke opened slightly. When engine starts, open choke gradually.



CAUTION: When using rope starter to crank engine, use caution so knotted end of rope does not strike persons standing nearby.

TO STOP ENGINE

Move control to "STOP" or "OFF" position. Do not choke the carburetor to stop engine.

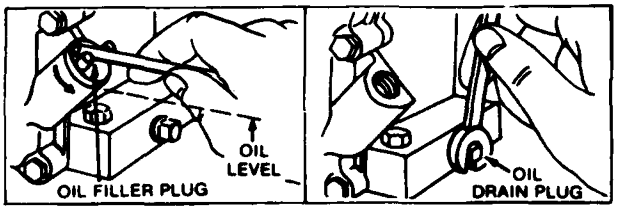


MAINTENANCE

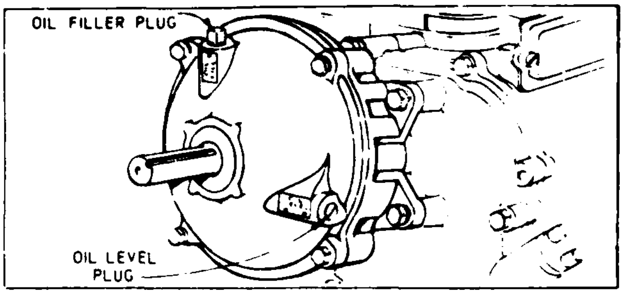
WARNING: TO PREVENT ACCIDENTAL STARTING when servicing the engine or equipment, always remove the spark plug or wire from the spark plug and insert in holding tab shown on page 2.

CHECK OIL LEVEL regularly — after each five hours of operation. BE SURE OIL LEVEL IS MAINTAINED.

CHANGE OIL after first five hours of operation. Thereafter change every 25 hours of operation. Remove oil drain plug and drain oil while engine is warm. Replace drain plug. Remove oil fill plug, oil-minder, or cap and dipstick and refill with new oil of proper grade. Replace oil fill plug, oil-minder or cap and dipstick.



CHANGE OIL (GEAR REDUCTION optional). Remove oil level plug and oil fill plug. Drain oil every 100 hours of operation. To refill, pour 10W-30 oil into filler hole until it runs out level check hole. Replace both plugs. Oil fill plug has a vent hole and must be installed on top of gear case cover.



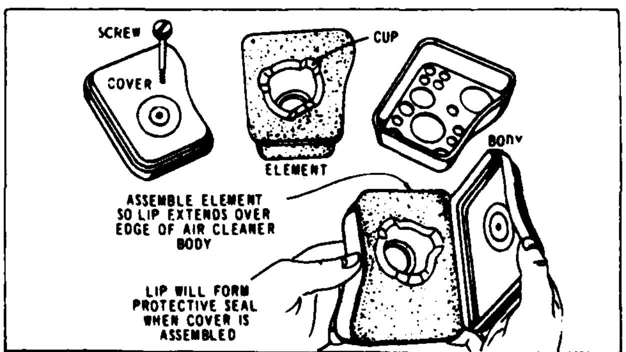
TO SERVICE AIR CLEANER

"OIL FOAM" AIR CLEANER

Clean and re-oil foam element at three month intervals or every 25 hours, whichever occurs first.

NOTE: Service air cleaner more often under dusty conditions.

1. Remove screw.
2. Remove air cleaner carefully to prevent dirt from entering carburetor.
3. Take air cleaner apart and clean.
   a. WASH foam element in kerosene or liquid detergent and water to remove dirt.
   b. Wrap foam in cloth and squeeze dry.
   c. Saturate foam with engine oil. Squeeze to remove excess oil.
4. Reassemble parts and fasten to carburetor securely with screw.



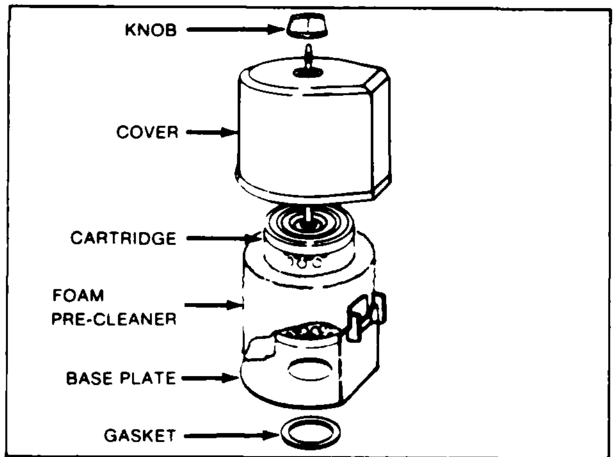
OIL FOAM AIR CLEANER

DUAL ELEMENT AIR CLEANER (OPTIONAL)

Clean and re-oil foam pre-cleaner at three month intervals or every 25 hours, whichever occurs first.

NOTE: Service more often under dusty conditions.

1. Remove knob and cover.
2. *Remove foam pre-cleaner by sliding it off of the paper cartridge.*
3. a. Wash foam pre-cleaner in kerosene or liquid detergent and water.
   b. Wrap foam pre-cleaner in cloth and squeeze dry.
   c. Saturate foam pre-cleaner in engine oil. Squeeze to remove excess oil.
4. Install foam pre-cleaner over paper cartridge. Reassemble cover and screw knob down tight.

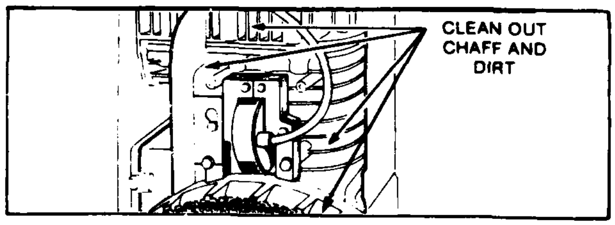


DUAL ELEMENT AIR CLEANER

Yearly or every 100 hours, whichever occurs first, remove paper cartridge. Clean by tapping gently on flat surface. If very dirty, replace cartridge, or wash in a low or nonsudsing detergent and warm water solution. Rinse thoroughly with flowing water from inside out until water is clear. Cartridge must be allowed to stand and air dry thoroughly before using. Service more often if necessary.

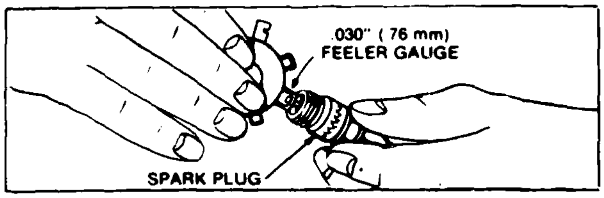
CAUTION: Petroleum solvents, such as kerosene, are not to be used to clean cartridge. They may cause deterioration of the cartridge. DO NOT OIL CARTRIDGE. DO NOT USE PRESSURIZED AIR TO CLEAN OR DRY CARTRIDGE.

CLEAN COOLING SYSTEM — Grass, chaff or dirt may clog the rotating screen and the air cooling system, especially after prolonged service cutting dry grass. Yearly or every 100 hours, whichever occurs first, remove the blower housing and clean the areas shown to avoid overspeeding, overheating and engine damage. Clean more often if necessary.



DANGER: Periodically clean muffler area to remove all grass, dirt and combustible debris.

SPARK PLUG — Clean and reset gap at .030" every 100 hours of operation.



CAUTION: Do not blast clean spark plug. Spark plug should be cleaned by scraping or wire brushing and washing with a commercial solvent.

Sparking can occur if wire terminal does not fit firmly on spark plug, or if stop switch vibrates against spark plug. Reform terminal or repair switch if necessary.

REMOVE COMBUSTION DEPOSITS every 100-300 hours of operation. Remove cylinder head and cylinder head shield. Scrape and wire brush the combustion deposits from cylinder, cylinder head, top of piston and around valves. Use a soft brush to remove deposits. Re-assemble gasket, cylinder head and cylinder head shield. Turn screws down finger tight with the three longer screws around the exhaust valve, if so equipped. Torque cylinder head screws in a staggered sequence to 140 inch pounds (15.82 Nm).

SPARK ARRESTER EQUIPPED MUFFLER — If engine muffler is equipped with spark arrester screen assembly, remove every 50 hours for cleaning and inspection. Replace if damaged.

CLEAN ENGINE — Remove dirt and debris with a cloth or brush. Cleaning with a forceful spray of water is not recommended as water could contaminate the fuel system.

ADJUSTMENTS

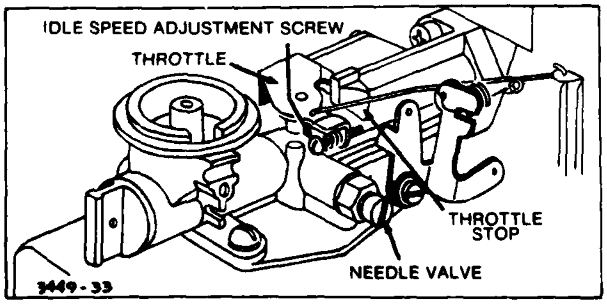
CARBURETOR ADJUSTMENTS

Minor carburetor adjustment may be required to compensate for differences in fuel, temperature, altitude or load.

NOTE: The air cleaner must be assembled to carburetor when running engine.

TO ADJUST CARBURETOR — Gently turn valve clockwise until it just closes. Valve may be damaged by turning it in too far.

Now open needle valve 1-1/2 turns counterclockwise. This initial adjustment will permit the engine to be started and warmed up (approximately 5 minutes) prior to final adjustment.



FINAL ADJUSTMENT

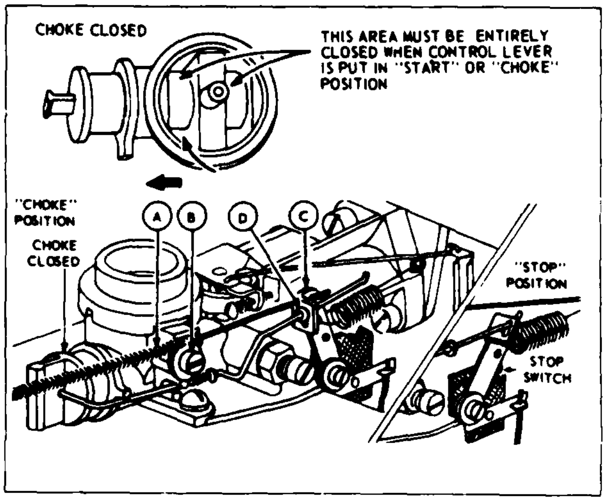
Place speed control lever in "FAST" position. Turn needle valve in until engine slows (clockwise — lean mixture). Then turn it out past smooth operating point until engine runs unevenly (rich mixture). Now turn needle valve to the midpoint between rich and lean so the engine runs smoothly. Next, adjust idle RPM. Rotate throttle counterclockwise and hold against stop while adjusting idle speed adjusting screw to obtain 1750 RPM. Release throttle — engine should accelerate without hesitation or sputtering. If engine does not accelerate properly, the carburetor should be re-adjusted, usually to a slightly richer mixture.

CONTROL ADJUSTMENTS

The speed control must be properly adjusted to stop, start and operate the engine at maximum speed.

TO CHECK OPERATION OF CHOKE CONTROLS:

Move speed control lever to "Choke" position. The carburetor choke should be closed.

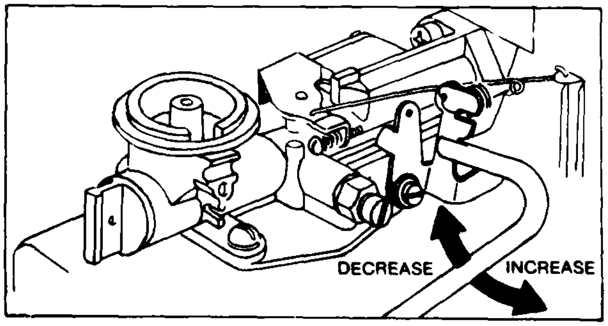


To Adjust:

Place speed control lever on equipment in "FAST" (high speed) position. Loosen control casing clamp screw (B) on carburetor. Move control casing (A) and wire forward or backward until speed lever (C) just touches the choke operating link at (D). Tighten casing clamp screw (B) on carburetor. Recheck operation of controls after adjustment. Move control lever to "STOP" position. Lever must make good contact with stop switch if so equipped. Replace air cleaner.

SPEED CONTROL ADJUSTMENT

The acceptable operating speed range is 1800 to 3600 RPM. Idle speed is 1750 RPM. The manufacturer of the equipment on which the engine is used, specifies the top governed no load speed at which the engine may be operated. DO NOT EXCEED this speed.



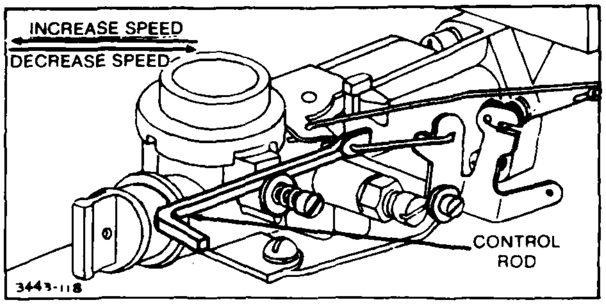
Standard Control

To increase engine speed, bend tang to lengthen governor spring.

To decrease engine speed, bend tang to shorten governor spring.

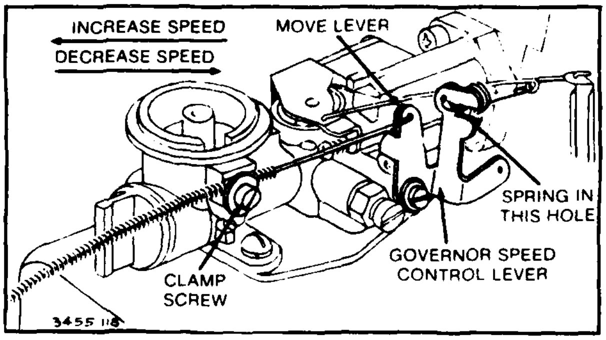
Manual Friction Control

To increase or decrease engine speed, move control rod as shown.



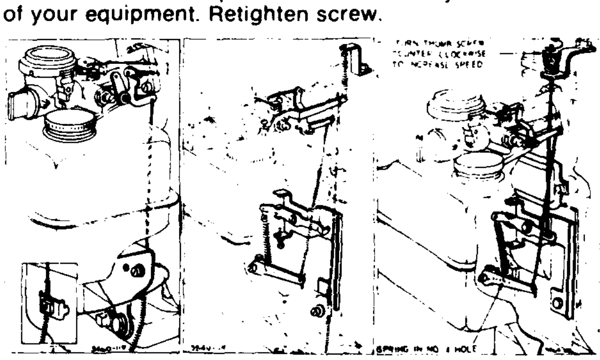
Speed Control

Controls on powered equipment should move governor speed lever in a direction that will elongate governor spring to increase speed.



To Adjust:

Loosen clamp screw on carburetor or fuel tank bracket and move casing in or out to obtain proper speed. DO NOT EXCEED maximum speed recommended by manufacturer of your equipment. Retighten screw.



MECHANICAL GOVERNOR

To Adjust:

Speed adjusting thumb nut is located on top of engine. To increase speed turn adjusting thumb nut counter-clockwise.

GENERAL INFORMATION

This engine is a single-cylinder L-head, air-cooled type.

MODEL SERIES 80200 to 82200

Bore	2-3/8" (60.33 mm)
Stroke	1-3/4" (44.45 mm)
Displacement	7.75 cu. in. (127.0 cc)
Horsepower Max.	3.0 @ 3600 RPM
Torque (Ft. Lbs.) Max.	4.6 @ 3100 RPM

The horsepower rating listed is established in accordance *with the Society of Automotive Engineers Test Code - J607*. For practical operation, the horsepower loading should not exceed 85% of this rating. Engine power will decrease 3½% for each 1,000 feet (304.8 m) above sea level and 1% for each 10° above 60° F (16° C).

In some areas, local law requires the use of a resistor spark plug so as to suppress ignition signals. If an engine was originally equipped with a resistor spark plug, be sure to use the same type of spark plug for replacement.

TUNE-UP SPECIFICATIONS

Spark Plug Type	Champion	Autolite
Short Plug	CJ-8	235
Long Plug	J-8	295
Resistor Short Plug	RCJ-8	245
Resistor Long Plug	RJ-8	306

Spark Plug Gap	.030" (.76 mm)
Intake Valve Clearance	.005" - .007" (.13 - .18 mm)
Exhaust Valve Clearance	.009" - .011" (.23 - .28 mm)

STORAGE INSTRUCTIONS

Engines to be stored over 30 days should be completely drained of fuel to prevent gum deposits forming on essential carburetor parts, fuel filter and tank.

NOTE: The use of a fuel additive, such as STA-BIL, or an equivalent, will minimize the formation of fuel gum deposits during storage. Such an additive may be added to the gasoline in the fuel tank of the engine, or to the gasoline in a storage container.

a. All fuel should be removed from the tank. Run the engine until it stops from lack of fuel. The small amount of fuel that remains in the sump of the tank should be removed by absorbing it with a clean, dry cloth.

b. While engine is still warm, drain oil from crankcase. Refill with fresh oil.

c. Remove spark plug, pour approximately 1/2 ounce (15 cc) of engine oil into cylinder and crank slowly to distribute oil. Replace spark plug.

d. Clean dirt and chaff from cylinder, cylinder head fins, blower housing, rotating screen and muffler areas.

e. Store in a clean and dry area.

BRIGGS & STRATTON ENGINES ARE MADE UNDER ONE OR MORE OF THE FOLL ATENTS

2.999.491	3.305.223	3.526.146	3.625.492	3.745.393	971.353	4.233.043	DESIGN
3.194.224	3.457.804	3.572.218	3.650.354	3.961.724	168.288	4.270.509	D-247.177
3.276.439	3.465.740	3.625.071	3.738.345	3.968.854	189.040		OTHER PATENTS PENDING

7.4 SHIPPING

7.4.1 Regulation Review

The research and review of DOD and DOT regulations (effective in 1984) provided the following information pertinent to the transport of hazardous material contained in the geotechnical diver tool kits.

7.4.1.1 Hazardous Material Definitions.

- Combustible Liquids (49 CFR 173.115, Appendix B). Any liquid that has a flashpoint between 100 and 200°F. (IATA specifies a flashpoint between 140 and 200°F.)

- Flammable Liquids (49 CFR 173.115, Appendix B). Any liquid that has a flashpoint below 100°F.

- Compressed Gases, Flammable (49 CFR 173.300, Appendix B). Any material or mixture having a pressure exceeding 40 psi at 7°F; or, regardless of the pressure at 70°F, having an absolute pressure exceeding 104 psi at 130°F; or any liquid flammable material having a vapor pressure exceeding 40 psi at 190°F as determined by ASTM Test D-323.

- Corrosive Material (49 CFR 173.240, Appendix B). Any liquid or solid that causes visible destruction or irreversible alterations in human skin tissue or whose corrosion rate exceeds 0.25 inch per year on steel (SAE 1020) at 130°F.

7.4.1.2 General Packaging Requirements. General packaging requirements that may be applied to all classes of hazardous material in the geotechnical diver tool kits are as follows:

- CFR 172.312 (Appendix B) provides that any package of liquid hazardous material must be packed with closures upward and legibly marked "This Side Up" or "This End Up" to indicate the upward position of the inside packaging.

- CFR 173.6 (Appendix B) states that any container with a capacity of 110 gallons or less, containing liquid, must have sufficient expansion space to prevent the liquid from completely filling the container at 130°F.

7.4.1.3 Packaging Requirements for Combustible Liquids. There are no specific packaging requirements for the combustible liquids in the geotechnical diver tool kits except that the package must be marked "Combustible Liquids."

7.4.1.4 Packaging Requirements for Flammable Liquids.

- CFR 173.119 (Appendix B) states that the material must be shipped in wooden boxes with an inside container. The inside container must be metal pails or cans not to exceed 10 gallons. The boxes must conform to CFR 178.168 (Specification 15A), 178.169 (Specification 15B), 178.170 (Specification 15C), 178.185 (Specification 16A), 178.190 (Specification 19A), or 178.191 (Specification 19B) (Appendix B).

- CFR 172.101 (Appendix B) restricts the quantity to be shipped on passenger-carrying aircraft to 1 quart.

- CFR 173.120 (Appendix B) provides that an engine or motor (internal combustion) using liquid fuel classes as flammable liquid, whether shipped separately or as a part of another apparatus, must have its fuel tank completely drained. Fuel may be left in the carburetor, fuel pump, and fuel lines provided the total flammable liquid content does not exceed 16 ounces and provided the lines are tightly closed to prevent leakage of the fuel.

- NAVSUP Publication 505 (CH-4), paragraph 6-28 (Appendix A), states that fuel systems on engines shipped by military aircraft must be completely drained (including tank, carburetor, fuel pump, and lines), purged, and sealed with proper plugs, caps, and covers.

7.4.1.5 Specific Packaging Requirements for Flammable Gases.

- CFR 173.305 (Appendix B) states that the container of flammable gases must be

packaged in a strong wooden or fiber box of such design as to protect valves from injury or accidental functioning under conditions incident to transportation.

• CFR 172.101 (Appendix B) prohibits flammable gases on passenger-carrying aircraft and limits the quantity to 300 pounds on cargo aircraft.

7.4.1.6 Specific Packaging Requirements for Corrosive Materials.

• CFR 173.263 (Appendix B) requires the material be in wooden boxes with inside containers not over 1 gallon each that are made of glass, earthenware, polyethylene, or other nonfragile plastic resistant to corrosive material (bags are not authorized). As an exception, inside containers up to 3 gallons each are authorized when only one is packed in each outside container. The wooden boxes must conform to CFR 178.168 (Specification 15A), 178.169 (Specification 15B), 178.170 (Specification 15C), or 178.190 (Specification 19A) (Appendix B).

• CFR 173.244 (Appendix B) provides an exception to the above requirement when the material is shipped in limited quantities of not over 16 ounces by volume, each enclosed in a metal or plastic container, and packed in a strong outside container.

7.4.1.7. Label Requirements. In addition to normal labeling requirements for shipment of military cargo, the following hazardous material labeling requirements are imposed.

• CFR 172.300 (Appendix B) requires each package of hazardous material to be marked with the proper shipping name and hazard class (i.e., combustible liquid, flammable liquid, flammable gas, or corrosive material). The hazard class is to be followed by the designation N.O.S. (not otherwise specified).

• MIL-STD-129H, paragraph 5.4.34 (Appendix C), requires that any package containing flammable or combustible liquids with a flashpoint below 200°F be marked with the flashpoint of the material. In addition, if the flashpoint is below 73°F, the boiling point must also be marked.

• DOT-P-5800.2, "Hazardous Material Emergency Response Guidebook," requires that all packages containing hazardous materials be marked with an ID number to identify the type of material and the response required in case of fire, spill, or other accident. These ID numbers are prefixed in one of two ways: UN for United Nations or NA for North America. All packages shipped commercially within the United States should have an ID number prefixed with NA. Packages shipped commercially outside the U.S. should bear an ID number prefixed with UN. All packages shipped by military aircraft should have the ID number prefixed with NA. The ID numbers required by materials in the geotechnical diver tool kits are:

- Combustible Liquids	1993
- Flammable Liquids	1993
- Flammable Gas	1954
- Corrosive Material	1760

• MIL-STD-129H, paragraph 5.4.2 (Appendix C), requires that containers that must be stacked with the top surface up (to assure the safety of interior packaging/contents) be marked with the word "UP" and an arrow pointed toward the top of the container. Markings for rectangular containers will be on two sides, and for cylindrical containers two equidistant points on the circumference. The length of the arrow shall not be less than 1 inch, and the stem not less than 1/2 inch in width, and size shall be proportioned to the available space.

• CFR 172.402 (Appendix B) requires that any package transported by air containing a hazardous material that is authorized only on cargo aircraft shall be labeled with a "Cargo Aircraft Only" label described in CFR 172.448 (Appendix B).

• CFR 172.101 (Appendix B) requires that any package containing a flammable liquid be labeled with a "Flammable Liquid" label described in CFR 172.419 (Appendix B).

• CFR 172.101 (Appendix B) requires that any package containing a corrosive

material be labeled with a "Corrosive" label described in CFR 172.442 (Appendix B).

• CFR 172.304 (Appendix B) requires that any markings required for hazardous material must be located away from any other marking that could substantially reduce its effectiveness.

7.4.1.8 Certification Requirements. Materials classed as combustible liquids with flashpoints below 141°F require certification. The person who signs these certifications must be certified as authorized to sign them by the Navy School of Transportation Management. IATA Restricted Articles Regulations require that DOT Form 30-061 be filed with all shipments of hazardous materials on commercial aircraft, both domestic and international. Instructions for filing this form are contained in Appendix D. NAVSUP Publication 505 (CH-4) (Appendix A) requires that DD Form 1387-2 be filed with all shipments of hazardous materials on military aircraft. Instructions for filing this form are also contained in Appendix A. CFR 107.371 (Appendix B), Section 110(b) of 49 U.S.C. 1809(b), dictates a U.S. criminal penalty of a fine of not more than $25,000 and imprisonment for not more than 5 years, or both, for any person who willfully violates a provision of the Act or a regulation issued under the Act.

7.4.2 Analyses

Most of the items in the geotechnical diver tool kit, such as the hand-powered tools and spare parts, fall in the category of nonregulated material. The remaining items belong to one of four categories of hazardous material as defined in 49 CFR 173.

• Combustible Liquids. Diesel fuel is classed as a combustible liquid. This can be shipped by air in any amount without special packaging or certification.

• Flammable Liquids. Items in the geotechnical diver tool kit classed as flammable liquids are the gas can and the gasoline engine-powered water pump. These items fall in this category only if gasoline is, or has been, present in the can or the gas engine fuel system, and they have not been cleaned or purged. The amount of gasoline that is allowed for air shipment is 1 quart on passenger aircraft and 10 gallons on cargo-only flights. The shipment of gasoline requires special packaging, labeling, and certification as stated in paragraphs 7.4.1.4, 7.4.1.7, and 7.4.1.8 of this report.

• Flammable Gases. The following items considered for the geotechnical diver tool kit are classed as flammable gases:

- LPS1, Greaseless Lubricant
- LPS2, General Purpose Lubricant
- LPS3, Heavy Duty Rust Inhibitor
- WD-40, Lubricant/Penetrant

These items are classed as flammable gases only because they are packaged in aerosol containers. Otherwise the LPS lubricants would be classed as combustible liquids and the WD-40 lubricant/penetrant as a flammable liquid. These items require special packaging, labeling, and certification as stated in paragraphs 7.4.1.5, 7.4.1.7, and 7.4.1.8 of this report.

7.4.3 Conclusions

7.4.3.1 Changing Classification. All items in the geotechnical diver tool kit except WD-40 may be downgraded to the combustible liquid class by either cleaning and purging or by changing the method of packaging. This will enable all items except the WD-40 to be shipped by either commercial or military air transport without special packaging, labeling, or certification requirements. WD-40 was eliminated from the kits.

7.4.3.2 Packaging and Certification. When the geotechnical diver tool kit is shipped from a military installation, the packaging and certification requirements are best performed by qualified specialists at that installation. However, when the geotechnical diver tool kit is shipped to a location where these specialists are not available, it must be repacked and certified for return shipment by the user. This will require that someone on the team be authorized to sign the certification papers.

7.4.4 Recommendations

When shipping the geotechnical diver tool kits, it is recommended that as many hazardous items as possible be downgraded to the combustible liquid classification. This will significantly reduce the requirements for special packaging, labeling, and certification. Specific recommendations for accomplishing this are as follows.

7.4.4.1 Clean and Purge the Gas Can and Gas Engine-Powered Water Pump. If the gas can and gas engine-powered water pump are cleaned and purged, they may be downgraded from the flammable liquid classification to the combustible liquid classification, thereby not requiring special packaging, labeling, or certification. A procedure to accomplish this is as follows:

<u>*Gas Can*</u>

- Purge gas can thoroughly with diesel fuel.
- Purge gas can with air, CO_2, or nitrogen.
- Repeat first two steps.
- Cap gas can tightly.

The gas can is now considered a combustible liquid and the box in which it is packed must be marked "Combustible Liquid."

<u>*Gas Engine-Powered Water Pump*</u>

- Drain fuel from fuel tank.
- Run engine until all residual fuel is expended.
- Purge fuel tank and carburetor with diesel fuel.
- Purge tank and carburetor with air, CO_2, or nitrogen.
- Repeat previous two steps.
- Cap tank with an unvented cap. (This cap must be replaced with the vented cap for operation.)

This procedure satisfies the most stringent of the two regulations covering gas engines. The gas engine is now classed as a combustible liquid and the box in which it is packed must be marked "Combustible Liquid."

7.4.4.2 Provide LPS Lubricants in Bulk Form. The LPS lubricants are classed as flammable gas only because they are packaged in aerosol cans. If these items were provided in bulk form, such as quart or gallon cans, they could be classed as a combustible liquid. As such, these items would not be subject to special packaging, labeling, or certification requirements. When provided in bulk form, these items should be accompanied by plastic spray bottles and/or brushes for application.

7.4.4.3 Eliminate the WD-40 Lubricant/ Penetrant. Since the WD-40 has a flashpoint of 110°F, it must be classed as a flammable liquid even if supplied in bulk form. LPS lubricants can be substituted for the WD-40; therefore, the WD-40 can be eliminated without loss of effectiveness and the geotechnical diver tool kit will contain no flammable liquids.

CHAPTER 8

JET PROBE

8.1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

8.1.1 General Information

The jet probe is a hand-operated diver tool that probes seafloor sediment to a 10-foot depth. This probing can find bedrock, stiff soil layers, cobble, or pebble layers, and with practice, the operator can distinguish different soil layers. A photograph of the jet probe is shown in Figure 8.1. The major parts of the tool are identified in the photograph. The tool is 11 feet long and weighs 18 pounds in air and 15 pounds in seawater. The time required to probe the sediment to a 10-foot depth depends on the soil type. The probe time is approximately 10 minutes or less for one probe.

The jet probe is packaged as a kit together with the vacuum corer kit in one box. Spare and repair parts for the jet probe are in the kit. Some of the tool parts and support equipment (water pump and hoses) are shared between the jet probe and the vacuum corer. The plywood box is larger than the other boxes in the set. The box is 4 feet long, 2 feet wide, and 4 feet tall. It weighs 450 pounds when fully equipped.

The geotechnical data taken with the jet probe are in-situ data. The data are measurements of the depth of the layer of sediment over bedrock or other impenetrable layer. With practice, a diver can tell by the vibrations felt in the jet probe pipe the difference between sand and clay and recognize cobble and seashell layers. Divers can map the sediment depth and type within 10 feet of the seafloor over an area using the jet probe.

8.1.2 Safety Precautions

The jet probe is a hand-operated tool that presents few safety hazards to the diver using it underwater. The major hazards for the jet probe are due to the water pump on deck. This water pump is driven by a gasoline engine. Safety precautions for this water pump and gasoline engine are covered in Chapter 7. For the diver using the tool underwater, the following precautions apply:

1. Do not turn off the water flow through the jet probe while it is inserted in the seafloor. You may not be able to pull it back out.

2. Do not point the jetting end of the tool at anyone; the water jet can cause injury.

3. Store waterhoses with camlocks connected to prevent damage to connectors.

8.2 FUNCTIONAL DESCRIPTION

8.2.1 Introduction

This section provides a functional description of the jet probe tool and the theory of operation.

8.2.2 Tool Function

The function of the jet probe is to probe the seafloor sediment to a depth of 10 feet to determine what is there.

8.2.3 Functional Sequence

The water pump is primed and started. The divers either swim the jet probe down or it can be lowered by a line. Once on the

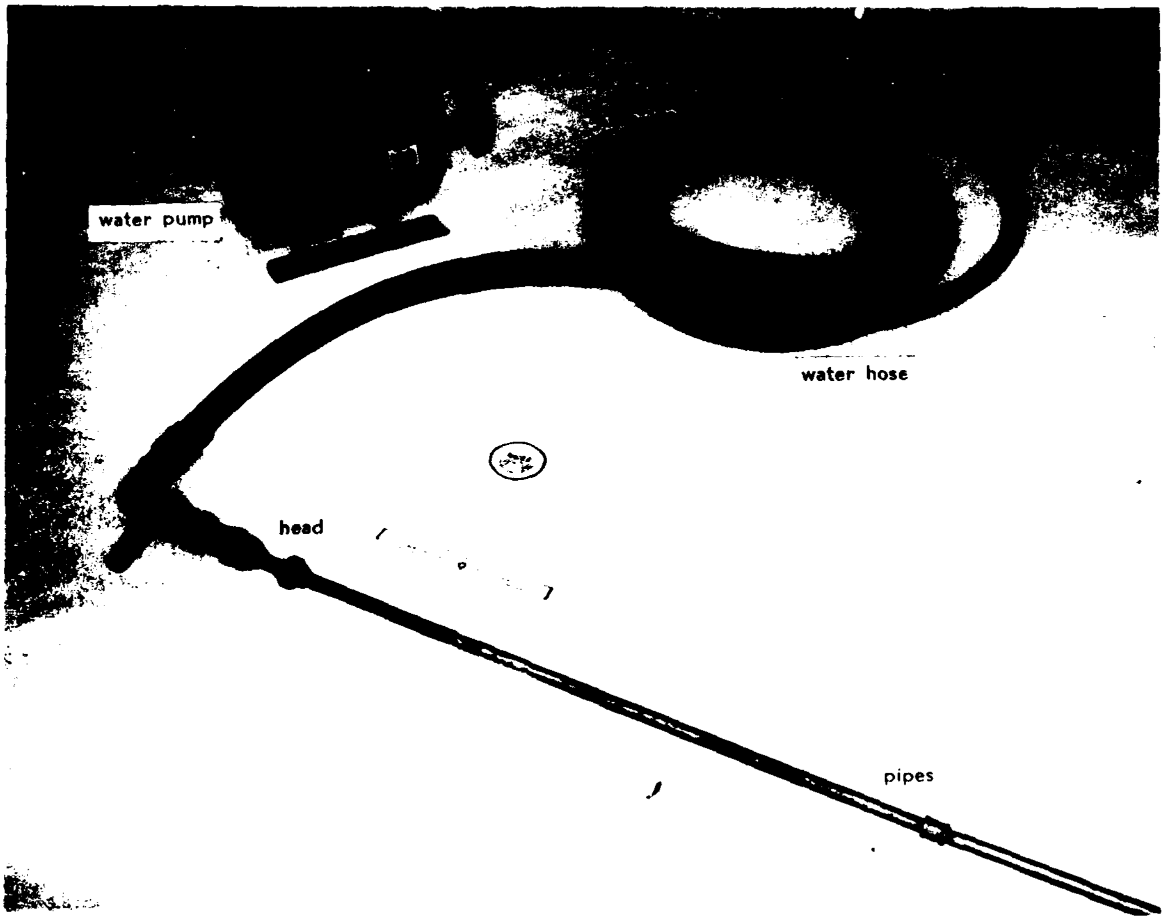


Figure 8.1. Jet probe.

seafloor, the divers stand the jet probe up in a position ready to push it into the soil. One diver should be at the valve on top and the other diver should be near the bottom of the probe at the seafloor to guide the probe. As they begin to push down on the probe, the on-off valve is opened. The jet probe is pushed into the sediment and the divers notice the type of sediment washed up and the feel of the vibrations on the pipe. When bedrock is hit or other hard surface so that the probe does not penetrate any further, the divers note how deep it is in the seafloor and record this on a slate. The jet probe is pulled out and turned off.

8.2.4 Component Function and Theory of Operation

8.2.4.1 Water Pump. The water pump provides a source of pressurized water to force through the jet probe. The pressurized water fluidizes the soil in front of the jet probe tip and allows the probe to penetrate. The pressurized water also washes the soil up around the pipe, keeping it in a fluid state so the probe does not get stuck in the seafloor. If the flow of water stops, the probe may be permanently stuck even if the flow is started up again.

8.2.4.2 **Jet Probe Head**. The head contains the on-off valve (a ball valve) and provides a connection between the water pump and the probe pipes.

8.2.4.3 **Jet Probe Pipe**. The probe pipes penetrate the soil by providing a path for the pressurized water that fluidizes the soil. The small-diameter metal pipes also provide a source of vibrations that are related to the type of soil the pipe is passing through. These pipes are in lengths of 3 feet 4 inches to allow for easier packaging and are connected by couplings to make a 10-foot probe pipe.

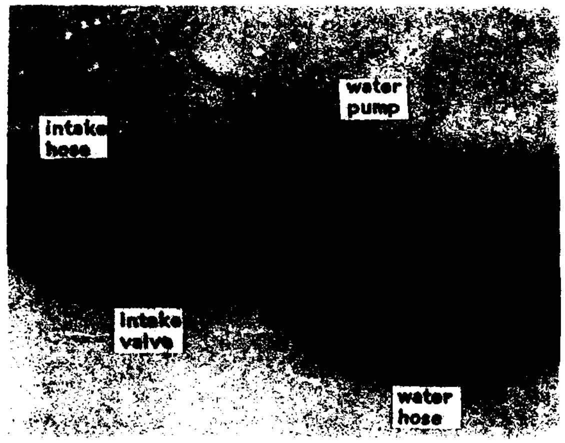


Figure 8.2. Water pump, intake valve and hose, and water hose.

8.3 ASSEMBLY, OPERATION, AND DATA RECORDING

8.3.1 Introduction

This section explains step-by-step the assembly, operation, and data recording for the jet probe. Before the jet probe is assembled for operation, Chapter 7 on the water pump and the gasoline engine should be read and understood.

8.3.2 Assembly

The steps to assemble the jet probe are given below. Refer to the Illustrated Parts Breakdown to identify the parts.

ASSEMBLY STEPS

1. Attach the intake valve to the intake hose (Figure 8.2).

2. Attach the intake hose to the water pump (Figure 8.2).

3. Attach the water hose to the water pump discharge (Figure 8.2).

4. Screw three sections of pipe together and then screw into jet probe head (Figure 8.1).

5. Attach jet probe head to water hose. Make sure that the on-off valve is closed (Figure 8.1).

6. Mark 1-foot intervals on the 10-foot pipe with wraps of electrical tape.

8.3.3 Operation

The operating steps for the jet probe are listed below. Before operating the jet probe, Chapter 7 must be read and understood.

OPERATION STEPS

1. Prime pump and start engine following manufacturer's instructions in Chapter 7.

2. Lower jet probe to seafloor with divers.

3. Divers locate spot to operate jet probe.

4. Diver #1 raises jet probe head until pipe is vertical (Figure 8.3). Diver #2 should be in a position near the bottom tip of the probe pipe.

5. Diver #1 begins pushing down on jet probe and turning on the valve (Figure 8.4). Diver #2 helps guide the probe in and keep it vertical.

6. Diver #2 should feel the pipe as it penetrates and try to observe the type of soil washed out.

7. Diver #1 can also keep a hand on the probe pipe to feel for the vibrations and help identify the soil (Figure 8.5).

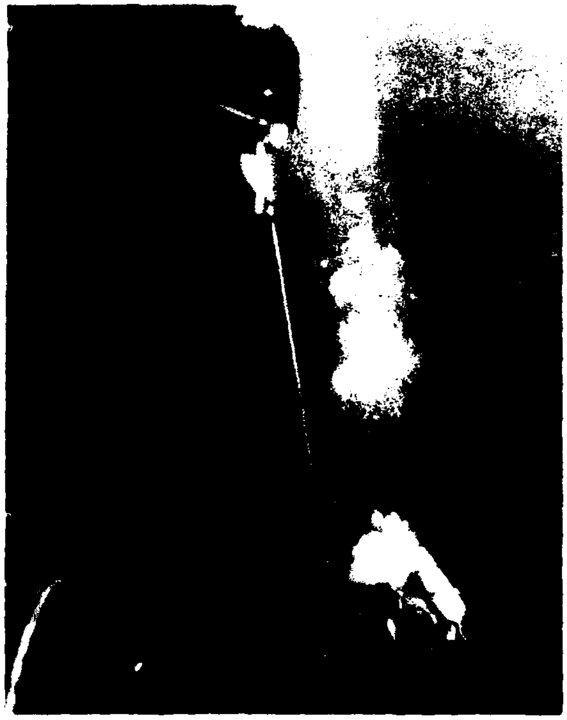


Figure 8.3. Divers positioning jet probe.

Figure 8.4. Turning valve on.

8. Diver #2 should note how deep the probe penetrates and mark (use lead pencil only) this depth on a slate. The depth can be estimated based on the pipe lengths, which are about 3-1/2 feet long. If the divers prefer, they can use tape to mark off 1-foot intervals along the pipe length.

9. When the probe will not penetrate any further or has penetrated 10 feet and the depth has been recorded, the jet probe should be pulled out. The probe should not be left in the seafloor any longer than necessary to avoid getting it stuck. The valve should not be turned off while the probe is inserted in the seafloor.

10. If the probe seems to be hitting something hard, move over a little and try again. By trying several probes at one spot, the divers may be able to tell if they hit bedrock or maybe just a rock.

8.3.4 Data Recording

The data taken with the jet probe consist of depth measurements and subjective judgments on soil type. The data taken with the jet probe are recorded on a diver's slate (Figure 8.6) and then later transferred to a data sheet (Figure 8.7). Use only a soft lead pencil on the slate; clean with a pencil eraser. The slate can be washed with cleanser soap and water. An example of a slate with jet probe data is shown in Figure 8.8, and a completed data sheet is shown in Figure 8.9. These completed data are from the example site survey from Chapter 2. Analysis of this data is discussed in Section 8.10.

8.3.5 Summary Instruction Sheet

The above instructions for the assembly and operation of the jet probe have been condensed to one page with an illustrated

Figure 8.5. Pushing in jet probe.

parts breakdown on the back (Figure 8.10). A copy of this page can be laminated and kept in the kit box for quick field reference. These instructions are very brief, intended to function as a reminder, so the manual should be read first.

8.4 SCHEDULED MAINTENANCE

8.4.1 Introduction

Maintenance on the jet probe tool should be performed periodically during storage, before, and after use. Maintenance procedures for after use are listed below. Maintenance procedures during storage and before use are about the same with the exceptions noted below.

8.4.2 After-Use Maintenance

The following maintenance steps should be performed after each use of the jet probe tool.

AFTER-USE MAINTENANCE STEPS

1. Take the tool apart, disconnecting hoses and water pump.

2. Wash all parts with freshwater using a wire brush as necessary to remove soil from the tool (Figure 8.11).

3. Dry the tool and apply a rust preventative, such as LPS-3, to all metal parts (Figure 8.12).

4. Apply Never-Seize to all threaded parts (Figure 8.13).

5. Drain hoses and water pump and allow to dry.

6. Place tool parts in the kit box for storage.

7. Follow manufacturer's instructions in Chapter 7 for the water pump.

8. Clean and dry all items before returning to the kit box. Coat all metal parts with a rust preventative.

8.4.3 During-Storage Maintenance

During-storage maintenance for the jet probe tool is the same as the steps for after-use maintenance. Steps 1 and 2 may be omitted if the tool appears to be clean.

8.4.4 Before-Use Maintenance

Before-use maintenance is the same as during-storage maintenance with the following step added.

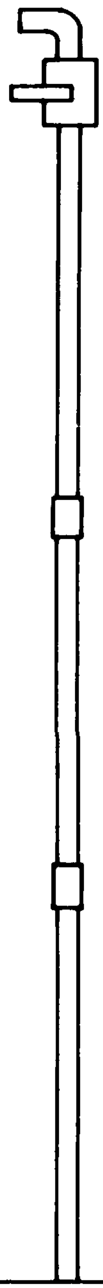
9. The operation of the water pump should be checked out prior to taking the pump out into the field for operation. See Chapter 7 for the manufacturer's instructions.

8.5 TROUBLESHOOTING

This section presents some of the common problems that might occur in the operation of the jet probe. The troubleshooting procedures are listed in Table 8.1. See Section 8.6 for corrective maintenance procedures.

USE SOFT LEAD PENCIL ONLY

JET PROBE



Site & Data ID	Depth (ft)	Bottom Description

NOTES:

Figure 8.6. Jet probe diver slate.

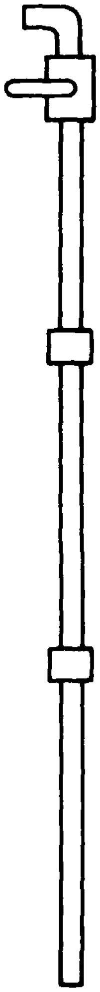
JET PROBE DATA SHEET

Project:

Date: Time:

Divers:

JET PROBE DATA FROM DIVER'S SLATE



Site + Data ID	Depth (ft)	Bottom Description

Observations:

Problems:

Figure 8.7. Jet probe data sheet.

USE SOFT LEAD PENCIL ONLY

JET PROBE

Site & Data ID	Depth (ft)	Bottom Description
BA-45	2	Sandy, exposed rock near by
BB-46	2½	"
BC-47	7	sandy, shells
BD-48	8	"
BE-49	7	sandy
BF-50	2	sandy, exposed rock
CA-59	4½	"
CB-60	3	"
CC-61	10+	sandy

NOTES:

Figure 8.8. Jet probe diver's slate with data from example survey in Chapter 2.

JET PROBE DATA SHEET

Project: Special Test Facility Project
Date: 14 Jun Time: 1325
Divers: Clark, Wright

JET PROBE DATA FROM DIVER'S SLATE

Site + Data ID	Depth (ft)	Bottom Description
BA-45	2	Sandy, exposed rock nearby
BB-46	2½	"
BC-47	7	sandy, shells
BD-48	8	sandy, shells
BE-49	7	sandy
BF-50	2	sandy, exposed rock
CA-59	4½	sandy, exposed rock
CB-60	3	sandy, exposed rock
CC-61	10+	sandy

Observations:

Problems:

Figure 8.9. Jet probe data sheet with data from example in Chapter 2.

JET PROBE INSTRUCTION SHEET

(See Operation and Maintenance Manual for complete instructions.)

I. SAFETY PRECAUTIONS:

1. Do not turn off water flow while jet probe is in seafloor, you may not be able to pull it out even if waterflow is turned on again.
2. Do not point water jet at anyone, it may cause injury.
3. See manual for proper operation and maintenance of water pump.

II. ITEMS DIVERS NEED:

1. Jet probe tool
2. Slate and pencil

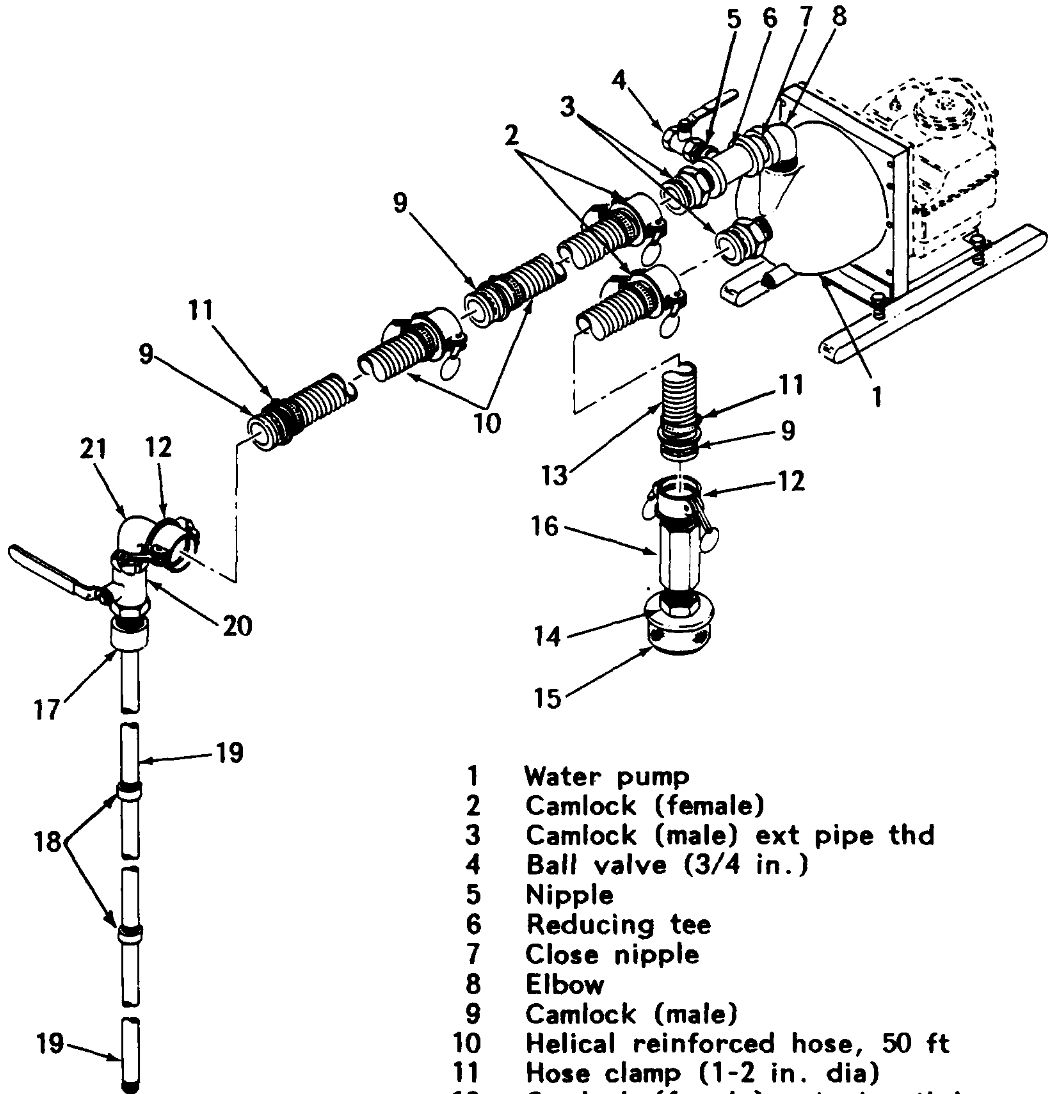
III. TOOL ASSEMBLY:

1. Start water pump (see manual).
2. Divers insert jet probe into soil and turn valve on.
3. Push jet probe into seafloor as far as possible; record depth on slate.
4. Repeat to cover area of interest.
5. Clean up tool according to manual instructions when finished operating.

IV. DATA OBTAINED:

1. Depth to bedrock or other hard layer, cobble layers, or shell layers can be determined with jet probe.
2. Data can be used to verify subbottom profile data.

Figure 8.10. Summary instruction sheet for jet probe.



1 Water pump
2 Camlock (female)
3 Camlock (male) ext pipe thd
4 Ball valve (3/4 in.)
5 Nipple
6 Reducing tee
7 Close nipple
8 Elbow
9 Camlock (male)
10 Helical reinforced hose, 50 ft
11 Hose clamp (1-2 in. dia)
12 Camlock (female) ext pipe thd
13 Helical reinforced hose, 20 ft
14 Close nipple, 1-1/2 in. NPT (brass)
15 Suction screen, 1-1/2 in. FEM NPT
16 Check valve (spring loaded poppit)
17 Bushing, 1-1/2 to 1/2 in. NPT
18 Coupling, 1/2 in. NPT
19 Pipe, 1/2 in. NPT x 42 in. (stainless steel)
20 Ball valve, 1-1/2 in.
21 Elbow (90°, ST, 1-1/2 in. NPT, brass)

JET PROBE

Table 8.1. Troubleshooting - Jet Probe

Problem	Probable Cause	Corrective Action
No flow or limited flow through jet probe	1. Something stuck in jet probe pipes	1. Remove pipe sections from head and separate sections; look in each section for blockage
	2. Something stuck in jet probe head, or on-off valve not working	2. Take head off pipe sections and check inside for blockage and proper working of ball valve
Cannot insert jet probe in seafloor	1. Rock in path of jet probe	1. Pull jet probe out, move over slightly, and try again
	2. No water flow	2. Pull jet probe out and check for water flow
Cannot pull jet probe out of seafloor	1. No water flow	1. Check on surface for state of water pump. If water pump is not running, start it up; however, you may still not be able to pull out the jet probe. Disconnect head and top pipe section, if possible, to recover; leave rest in seafloor

Figure 8.11. Cleaning threads.

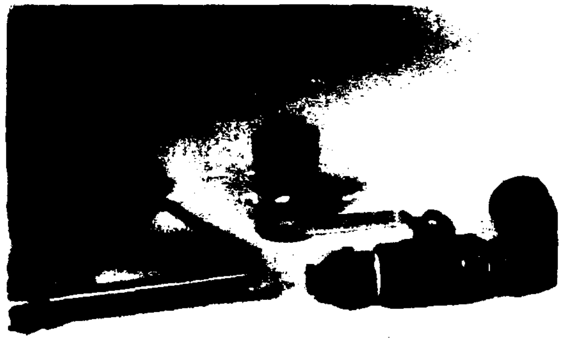


Figure 8.13. Lubricating threads.

Figure 8.12. Applying rust preventative to tool.

8.6 CORRECTIVE MAINTENANCE

8.6.1 Introduction

The corrective maintenance steps for the jet probe are simple and are described in the troubleshooting chart (Table 8.1); therefore, no specific maintenance procedures are given here.

8.7 ILLUSTRATED PARTS BREAKDOWN

8.7.1 Introduction

This section contains the illustrated parts breakdown (IPB) for the jet probe. The IPB consists of a parts list (Table 8.2) and an illustration (Figure 8.14). The parts in the list are indexed to the illustration, and the indexing reflects the disassembly sequence.

8.7.2 Parts List

The parts list (Table 8.2) includes all major components, assemblies, and detail parts for the jet probe. The illustrations (Figure 8.14) in the parts list are indexed in sequence of disassembly. Each illustrated part shown disassembled is assigned an index number. Parts shown as assemblies are listed

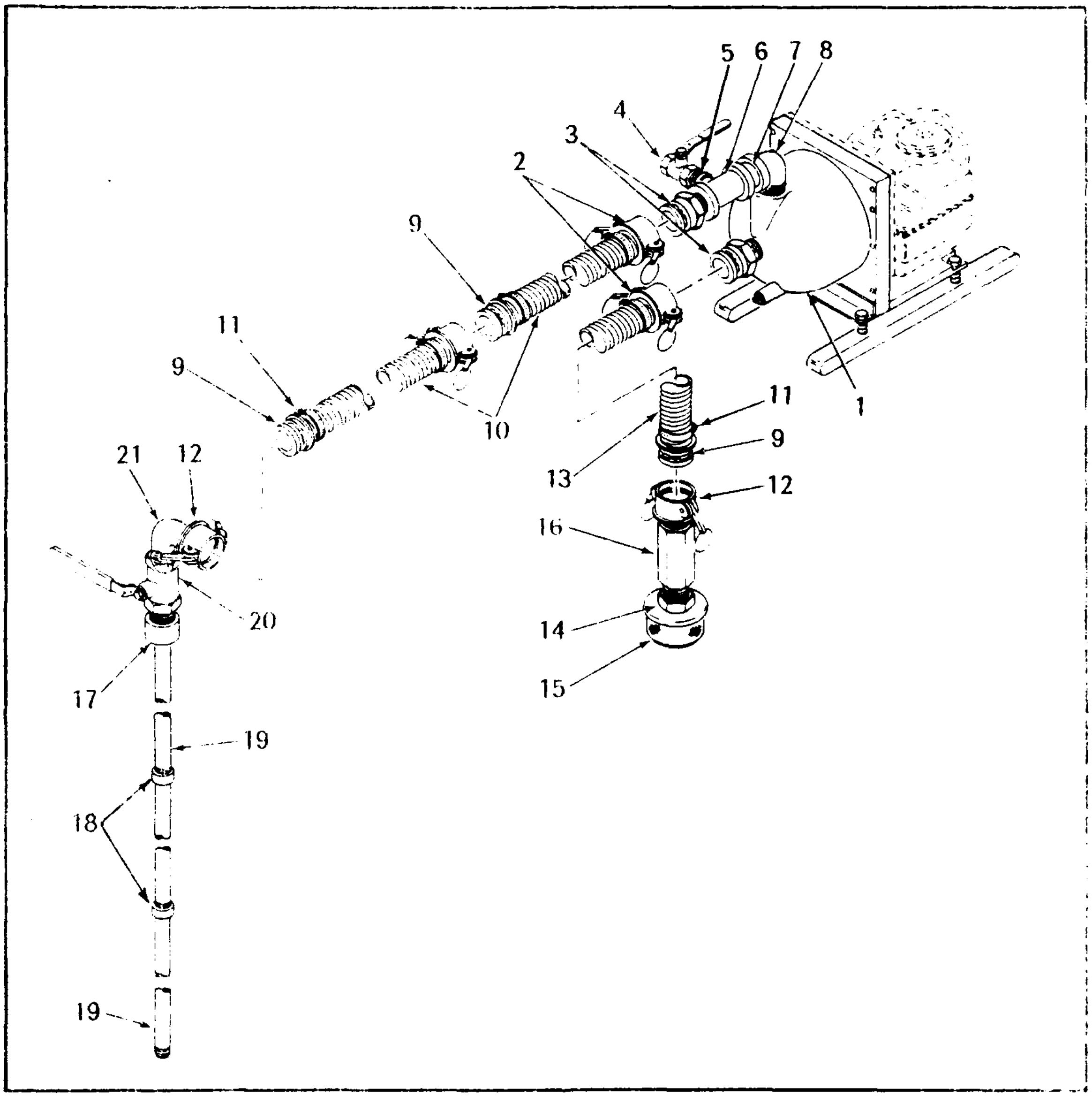


Figure 8.14. Jet probe.

Table 8.2. Parts List - Jet Probe

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
8.14-0		82-10-1F	1	JET PROBE (FOR NHA SEE FIG __)	80091	REF	
8.14-1		AP 315-1	2	PUMP, HOMELITE (PLASTIC)	35708	1	
8.14-2		MS27025-9	2	COUPLING, HALF, HOSE CONN, MIL-C-27487 (BRASS)	80091	3	
8.14-3		MS27022-9	2	COUPLING, HALF, EXT PIPE, MIL-C-27487 (BRASS)	80091	2	
8.14-4		1350-3/4	2	VALVE, BALL, 3/4 IN.	31995	3	
8.14-5		82-10-1F-15	2	NIPPLE, 3/4 IN. NPT	80091	2	
8.14-6		82-10-1F-14	2	TEE, REDUCING, 1-1/2 X 1-1/2 X 3/4 IN. NPT (BRASS)	80091	1	
8.14-7		82-10-1F-4	2	NIPPLE, CLOSE, 1-1/2 IN. NPT (BRASS)	80091	2	
8.14-8		82-10-1F-20	2	PIPE, 1/2 IN. NPT X 42 L	80091	5	
8.14-9		MS27021-9	2	COUPLING, HALF, HOSE CONN (BRASS)	80091	3	
8.14-10		82-10-1F-17	2	HOSE, HEAVY DUTY SUCTION/ DISCHARGE HELICAL REINFORCED PVC HOSE WITH A SMOOTH BORE	80091	1	

continued

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
8.14-11		6824	2	CLAMP, HOSE, 1 TO 2 IN. DIA	81646	6	
8.14-12		MS27026-9	2	COUPLING, HALF, EXT PIPE THD, MIL-C-27487 (BRASS)	80091	3	
8.14-13		82-101-1F-3	2	HOSE, 1-1/2 IN. ID, 20 FT L (PVC)	80091	1	
8.14-14		82-10-1F-4	2	NIPPLE, CLOSE, 1-1/2 IN. NPT (BRASS)	80091	2	
8.14-15		82-10-1F-3	2	SCREEN, SUCTION, 1-1/2 IN. FEM NPT	80091	1	
8.14-16		205	2	VALVE, CHECK, SPRING-LOADED POPPET, 1-1/2 IN. FEM NPT	75336	1	
8.14-17		82-10-1F-19	2	BUSHING, 1-1/2 TO 1/2 IN. NPT	80091	1	
8.14-18		82-10-1F-41	2	COUPLING, 1/2 IN. NPT	80094	4	
8.14-19		82-10-1F-20	2	PIPE, 1/2 IN. NPT X 42 IN. L	80091	5	
8.14-20		1350-1-1/2	2	VALVE, BALL, 1-1/2 IN.	31995	2	
8.14-21		82-10-1F-13	2	ELBOW, 90 DEG, ST, 1-1/2 IN. NPT (BRASS)	80091	2	

(whenever possible) with reference to the figure number that shows the part disassembled.

8.7.2.1 Figure and Index Number Column. The figure and index number column list is in numerical order. The figure and index number of each part is shown on the corresponding illustration.

8.7.2.2 Reference Designation Column. The reference designation column will remain blank because there are no designated electrical or electronic parts for the jet probe.

8.7.2.3 Part Number Column. The part number column lists the manufacturer or Government part number for all parts shown in the applicable drawings. An entry of COML designates that the part or material is generally available through a variety of commercial sources or vendors. This column may also contain a NO NUMBER entry, indicating that the part has no applicable part number but is identified for procurement by the data in the description column.

8.7.2.4 Indent Column. The numbers 1 through 3 in the indent column show the relationship of parts and subassemblies to assemblies and/or installations. For any given figure, a number 1 indent item is the top level of an assembly or installation, and a number 3 indent is the lowest level of disassembly.

8.7.2.5 Description Column. The description column contains descriptions of all parts listed in the applicable drawings. Modifiers are included to identify the characteristics of a particular item. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference. A cross-reference appears both in the listing where the assembly is first described and in the listing in which the assembly is broken down. In the latter, the abbreviation REF appears in the quantity per assembly column. Abbreviations in the description column are generally in accordance with MIL-STD-12C and/or as noted in the list of abbreviations and acronyms.

8.7.2.6 Manufacturer's Code Column. The manufacturer's code column lists numbers identifying the suppliers of the parts. Table 8.3 lists both suppliers and codes, which are also available in the Federal Supply Code for Manufacturers, Cataloging Handbooks H4-1 and H4-2.

8.7.2.7 Quantity Per Assembly Column. The quantity per assembly column contains one of the following entries: a numeral indicating the quantity of the item used only at the indicated location or the abbreviation REF, indicating that the required quantity is listed on the figure referenced in the description column.

8.7.2.8 Used-On Code Column. This column will remain blank because there are no used-on codes applicable to this parts list.

8.7.3 Abbreviations and Acronyms

The abbreviations and acronyms listed in Table 8.4 appear in the parts list and in the text of this manual. Abbreviations used in the text may be in lower case letters, initial capitals with lower case letters, or all capitals. Abbreviations used in the parts list are in all capitals. The abbreviations and acronyms listed in Table 8.4 are in all capitals for consistency.

8.8 TOOL KIT

8.8.1 Introduction

This section explains the function of the jet probe tool kit and presents a list of the kit contents and the purpose of each item. Procurement information is given in Section 8.11. An Illustrated Parts Breakdown for the tool is given in Section 8.7.

8.8.2 Tool Kit Function

The jet probe tool kit is designed to be self-sufficient in the field with the exception of a source of freshwater for washing down the tool after use and gasoline for the water pump. The jet probe kit is packaged in the same box as the vacuum corer kit, since some

Table 8.3. List of Manufacturers' Codes, Names, and Addresses

Code	Name and Address
02697	Parker-Hannifin Corporation Seal Group, O-Ring Division 2360 Palumo Drive Lexington, KY 40509
30781	Parker-Hannifin Corporation Packing Division 2220 S. 3600 W. Salt Lake City, UT 84119
31995	Jenkins Bros. 101 Merritt 7 Norwalk, CT 06851
35708	Textron Canada LTD Homelite-Terry Division 180 Labrosse Avenue P.O. Box 1800 Pointe Claire, Que Can H9R 4R6
39428	McMaster-Carr Supply Company P.O. Box 4355 Chicago, IL 60680
75336	Kingston F.C. Company 1007 N. Main Street Los Angeles, CA 90012
80091	Naval Facilities Engineering Command Washington, DC 20370
80094	Smith Herman H., Inc. 1913 Atlantic Avenue Manasquan, NJ 08736
81646	Ideal Corporation Sub of Parker-Hannifin Corporation 1000 Pennsylvania Avenue Brooklyn, NY 11207
95760	Protective Closures Company, Inc. 2150 Elmwood Avenue Buffalo, NY 14207
98773	Soiltest, Inc. 2205 W. Lee Street Evanston, IL 60202

Table 8.4. List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AP	Attaching Part
ASSY	Assembly
ASTM	American Society for Testing and Materials
COML	Commercial
CONN	Connector
CRES	Corrosion Resistant Steel
DEG	Degree
DIA	Diameter
EXT	Extension
FEM	Female
FIG	Figure
FT	Feet
GA	Gage
GAPL	Group Assembly Parts List
ID	Inside Diameter
IN.	Inch/Inches
INSTL	Installation
IPB	Illustrated Parts Breakdown
L	Long
MSPT	Miniature Standard Penetration Test
NHA	Next Higher Assembly
NPT	National Taper Pipe (Thread)
OD	Outside Diameter
PT	Point
PVC	Polyvinyl Chloride
REF	Referenced
SQ	Square
SS	Stainless Steel
ST	Street
STD	Standard
SUBASSY	Subassembly
THD	Thread

Figure 8.15. Jet probe/vaccum corer kit.

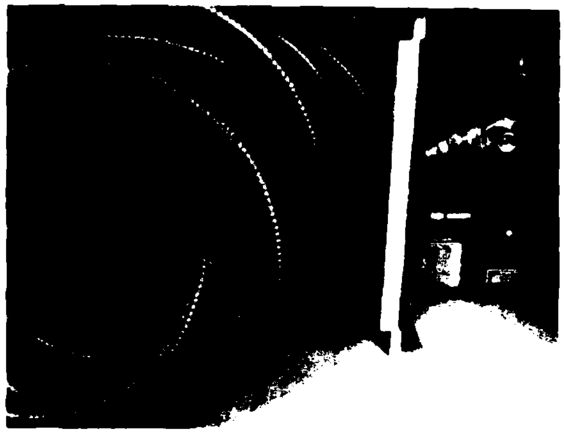


Figure 8.16. Bottom of jet probe kit box.

of the same equipment is used by both tools. This box is of plywood construction, 4 feet long, 2 feet wide, and 4 feet tall for a total cube of 32 ft^3. The complete box weighs 450 pounds when fully equipped. The kit contains all the spare and repair parts and supplies to operate the jet probe in the field (Figure 8.15). If only the jet probe is being used, the vacuum corer tray can be removed from the box and left out.

8.8.3 Tool Kit Contents

A list of the tool kit contents is shown in Table 8.5. The kit contents are listed as they are placed in the box, from bottom (Figures 8.16, 8.17, and 8.18) to top (Figure 8.19) and from back to front. A brief explanation of the function of each item in the kit is given in Table 8.6.

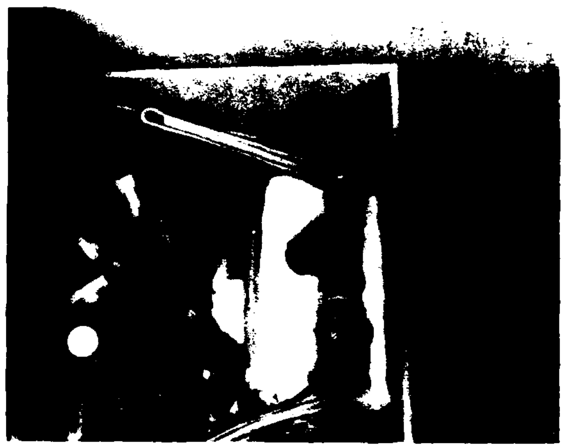


Figure 8.17. Jet probe kit pump tool box.

8.9 SHIPPING AND STORAGE

8.9.1 Introduction

The jet probe tool is designed to be stored in the kit box. The contents of the box were selected to allow the kit to be shipped by commercial and military truck, ship, and aircraft. Shipping regulations change over time, so current regulations should be checked before shipping the box.

Table 8.5. List of Contents - Jet Probe/Vacuum Corer

Item	No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier	Manufacturer/Supplier Part Number
1	1	Kit box			84-21-1F			
2	1	Water pump	8.20	8.14-1,3-8	82-10-1F	4,11-16	Homelite Div, Textron	AP-315-1
3	3	Water hose (50 ft)	8.20	8.14-2,9,11	82-10-1F	7,8,10,17	Local supplier	
4	1	Intake hose (20 ft)	8.20	8.14-2,9,11,13	82-10-1F	7,8,9,10	Local supplier	
5	1	Intake valve	8.20	8.14-12,14-16	82-10-1F	3,4,5,6	Local supplier	
6	1	Plastic bucket (4 qt)						FSN 7240-00-061-1163
7	1	Funnel						FSN 7240-00-527-9858
8	1	Wire brush (stainless steel)						FSN 7920-00-269-1259
9	1	Sparkplug					Champion	J8
10	2	Sparkplug socket, 3/8" drive						FSN 5120-00-678-2431
11	1	Handle, rachet, 3/8" drive						FSN 5120-00-240-5364
12	1	Extension, 3/8" x 2"						FSN 5120-00-243-1689
13	1	Adjustable wrench, 8"						FSN 5120-00-240-5328
14	1	Pliers, slip joint						FSN 5120-00-059-6711
15	1	Pliers, needlenose						FSN 5120-00-247-5177
16	1	Screwdriver, flat tip						FSN 5120-00-010-7915
17	2	Pipe wrenches, 18"						FSN 5120-00-277-1479
18	5	Hose mender (1-1/2")					Dixion	TM-21 (1-1/2")
14	10	Hose clamps (1-1/2")	8.20	8.14-11	82-10-1F	31	Local supplier	
20	1	Pipe dope					Locktite Pipe Sealant	59214
21	1	Silicone grease						FSN 6850-00-880-7616
22	1	Never-Seize						FSN 8030-00-180-6187
23	1	LPS-3 (1 gal bulk)					Local supplier	
24	1	Spray bottle - LPS-3						FSN 8125-00-488-7952
25	1	Spray bottle - water						FSN 8125-00-488-7952
26	2	Terry towel (pkg)						FSN 7920-00-823-9772
27	5	Lock ring	3.48	3.42-6	82-7-2F	13	Local machinist	
28	5	O-ring	8.20,9.20	9.14-22	82-10-1F	36	Local supplier	
29	100	3x5 cards						FSN MD 7530-00-247-6318
30	50	Plastic label bags						FSN 8105-00-756-2710
31	5	Electrical tape (rolls)						FSN 5970-00-788-4901
32	12	Black china markers						FSN 7520-00-223-6672
33	2	Tape measures						FSN 5210-00-054-1011

continued

Table 8.5. Continued

Item	Kit Contents No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier Part Number	Manufacturer/Supplier
34	10	Wire pieces, 6"					Local supplier	
35	12	Pencils						FSN 7510-00-286-5757
36	2	Erasers						FSN 7510-00-323-8788
37	2	Hacksaw						FSN 5110-00-289-9651
38	1	Hacksaw blade (pkg)						FSN 5110-00-277-4591
39	1	Spanner wrench	3.48	3.42-18	82-7-2F	18		
40	1	Vacuum corer head	8.20,9.20	9.14-20,25,29-30	82-10-1F	15,16,24,26,34	Local machinist	
41	2	Head nut	8.20,9.20	9.14-19,21,22	82-10-1F	25	Local machinist	
42	1	Eductor assembly	8.20,9.20	9.14-12,26,32-37	82-10-1F	6,18,21,22,28,29,35	Local machinist/supplier	
43	1	Vacuum hose (3/4")	8.20,9.20	9.14-23,24,27,28	82-10-1F	30,31,32,33	Local supplier	
44	5	Hose mender (3/4")					Dixion	TM-6 (3/4")
45	10	Hose clamps (3/4")	8.20,9.20	9.14-28	82-10-1F	31	Local supplier	
46	50	Core data sheets	B-5, 9.9					
47	5	Planning sheet	B-1					
48	5	Summary sheet	B-2					
49	5	Site data sheet	B-3					
50	5	Site sketch sheet	B-4					
51	5	Tool fail. & inadeq. report	B-10					
52	1	Summ. inst. sht-vacuum corer	9.10					
53	5	Jet probe pipes (3' 4")	8.20	8.14-19	82-10-1F	20	Local supplier	
54	1	Jet probe head	8.20	8.14-12,17,20,21	82-10-1F	6,13,18,19	Local supplier	
55	10	Pipe couplings	8.20	8.14-18	82-10-1F	41	Local supplier	
56	1	Jet probe slate	8.23				Local shop	
57	100	Jet probe data sheets	B-9 (8.7)					
58	5	Planning sheet	B-1					
59	5	Summary sheet	B-2					
60	5	Site data sheet	B-3					
62	5	Site sketch sheet	B-4					
62	5	Tool fail. & inadeq. report	B-10					
63	12	Pencils						FSN 7510-00-286-5757
64	2	Erasers						FSN 7510-00-323-8788
65	1	Summ. inst. sht-jet probe	8.10					
PACKAGED SEPARATELY								
66	20	Core tubes (8')	9.20	9.14-18	82-10-1F	23	Local supplier	

Table 8.6. Function of Kit Contents

Item	Description	Function in Kit
1	Kit box	Contain kit contents; shipping package
2	Water pump	Pump water to tools (see Sections 8.2.4.1 & 9.2.4.1)
3	Water hose	Water flow from water pump
4	Intake hose	Intake water flow to pump
5	Intake valve	Filters intake flow
6	Plastic bucket	Bulk soil samples; hold water to clean tools; prime water pump
7	Funnel	Prime water pump
8	Wire brush	Clean tools
9	Sparkplug	Spare for water pump
10	Sparkplug socket	Repair water pump and tools
11	Rachet handle	Repair water pump and tools
12	Extension	Repair water pump and tools
13	Adjustable wrench	Repair water pump and tools
14	Pliers, slip-joint	Repair water pump and tools
15	Pliers, needlenose	Repair water pump and tools
16	Screwdriver	Repair water pump and tools
17	Pipe wrenches	Repair water pump and tools
18	Hose mender	Repair water and intake hoses
19	Hose clamps	Repair water and intake hoses
20	Pipe dope	Repair water pump and tools
21	Silicone grease	Lubricate O-ring
22	Never-Seize	Lubricate threads
23	LPS-3 (bulk)	Lubricate/rust preventative for tools
24	Spray bottle - LPS-3	Apply bulk LPS-3
25	Spray bottle - water	Clean head nut when changing core tubes
26	Terry towel	Clean and dry tools; wipe tool with rust preventor
27	Lock ring	Grips core tube inside head nut
28	O-ring	Seals vacuum corer head, especially gap in lock ring
29	3x5 cards	Label cores
30	Plastic label bags	Protect core labels
31	Electrical tape	Tape caps and labels on core tubes
32	Black china markers	Write on cores; write core labels
33	Tape measure	Measure core length
34	Wire pieces, 6"	"Burp" caps when putting on core tubes
35	Pencils	Record data on data sheets
36	Erasers	Correct mistakes on data sheets
37	Hacksaw	Cut off core tubes
38	Hacksaw blades	Refills for hacksaw
39	Spanner wrench	Loosen and tighten corer head nut
40	Vacuum corer head	Hold core tube
41	Head nut	Tightens to hold core tube in place
42	Eductor assembly	Creates suction in vacuum hose
43	Vacuum hose	Transfers suction to core tube
44	Hose mender	Mend vacuum hose breaks
45	Hose clamp	Hold hose menders in place
46	Core data sheet	Record information on cores
47	Planning sheet	Plan geotechnical site survey
48	Summary sheet	Summarize results of site survey
49	Site data sheet	Record data location coordinates
50	Site sketch sheet	Sketch site and mark and label data locations
51	Tool fail. & inadeq. report	Report problems with tools and kits
52	Summary inst. sheet	Quick-reference field use for tools
53	Jet probe pipes	Penetrate soil
54	Jet probe head	Control flow of jet probe
55	Pipe couplings	Connect jet probe pipes (spares)
56	Jet probe slate	Record jet probe data underwater; use pencil only; erase to clean
57	Jet probe data sheets	Record jet probe data; transfer from diver's slate
58	Planning sheet	Plan geotechnical site survey
59	Summary sheet	Summarize site survey
60	Site data sheet	Record data location coordinates
61	Site sketch sheet	Sketch site and mark and label data locations
62	Tool fail. & inadeq. report	Report problems with tools or kit
63	Pencils	Use on diver's slate and data sheets
64	Erasers	Clean diver's slate
65	Summary inst. sheet	Quick-reference guide for field use
66	Core tubes	Take and store cores

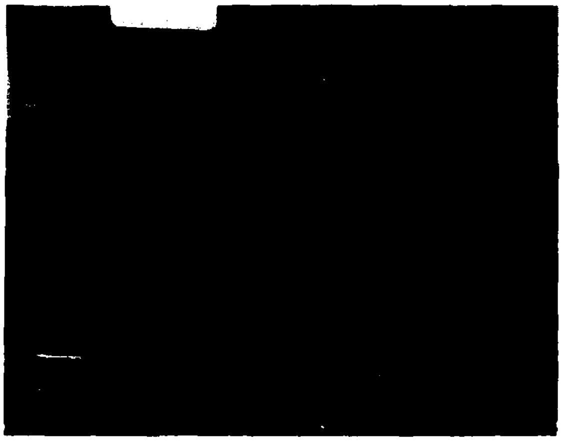


Figure 8.18. Vacuum core tray.

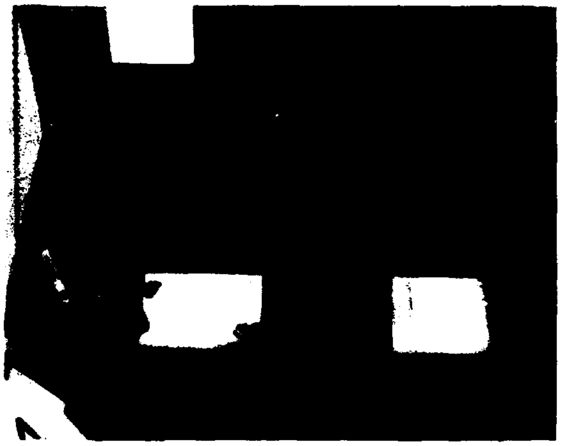


Figure 8.19. Jet probe tray.

8.9.2 Storage

Contents of the kit shall be prepared for storage by ensuring that all parts have been cleaned and all metal parts are coated with a rust preventative. For storage of the water pump, see Chapter 7.

8.9.3 Shipping

Current shipping regulations should be checked before shipping the jet probe kit. The items in the jet probe kit that require special care for shipping are the gasoline engine on the water pump and the rust preventative LPS-3. For the LPS-3, special shipping can be avoided by using it in bulk form. The aerosol packaging is what causes it to require special care. For the gasoline engine, the current regulations are given in Chapter 7. With bulk LPS-3 and proper purging of the gasoline engine, the kit box can be shipped as a combustible liquid. The box must be marked "COMBUSTIBLE LIQUID."

8.10 DATA ANALYSIS

The data gathered with the jet probe need little analysis. The penetration depths achieved can be used along with a chart of the area to get a profile of the rock or other impenetrable layer below the sediment. The information obtained with the jet probe is very useful for verifying results from a subbottom profiler.

8.11 PROCUREMENT INFORMATION

8.11.1 Introduction

All the necessary information to procure the jet probe diver tool, the jet probe/vacuum corer kit, and all its contents is contained within this manual. The information can be found in the following locations:

Table 8.5	List of Contents - Jet Probe/Vacuum Corer Kit	
Section 8.7	Illustrated Parts Breakdown - Jet Probe	
Section 8.11.2	Purchase Description	
Section 8.11.3	Manufacturers/Suppliers	
Section 8.11.4	Drawings	
Appendix B	Data Sheets	

8.11.2 Purchase Description

1. SCOPE. This purchase description establishes the requirements for the manufacture and acceptance of the geotechnical diver tools. The geotechnical tools consist of a miniature standard penetration test (MSPT) device, vane shear, impact corer, vacuum corer, jet probe, and rock classifier.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this purchase description to the extent specified herein.

DRAWINGS

Figure No.	NCEL Drawing No.	Title
8.20	82-10-1F	Jet Probe - Vacuum Corer
8.21	84-21-1F	Kit Box For Jet Probe - Vacuum Corer
8.22	84-21-2F	Kit Box For Jet Probe - Vacuum Corer
8.23	--	Diver's Slate - Jet Probe

(Copies of drawings required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this purchase description and the references cited herein, the text of this purchase description shall take precedence.

3. REQUIREMENTS

3.1 Drawings. The drawings referenced in 2.1.2 are level 2 end- product drawings. No deviation from the prescribed dimensions or tolerances is permissible without prior approval of the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation. Any data (such as shop drawings, layouts, flow sheets, and processing procedures) that are prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 Dimensions. All tool dimensions shall conform to the requirements specified in the end product drawings referenced in 2.1.2.

3.3 Materials. Materials shall be as specified herein and in other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this purchase description. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Materials shall conform to the requirements specified in the end product drawings listed in 2.1.2.

3.4 Workmanship. All parts, components, and assemblies of the geotechnical tools, including machined surfaces, seals, and welded parts, shall be clean and free from any defects in workmanship. External surfaces shall be free from burrs, slag, sharp edges, and corners except where sharp edges or corners are required.

3.5 Interchangeability. All parts referenced in the drawings in 2.1.2 that are described by the same part number shall be physically and functionally interchangeable.

3.6 Assembly. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.7 Threaded connections and fasteners. No threaded connections or fasteners shall show evidence of cross threading or mutilation.

3.8 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.9 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.10 Weights. Where indicated in drawings, weights of parts and subassemblies must be maintained within tolerances stated.

3.11 Seals. Where indicated in drawings, seals shall be installed with the necessary care required to maintain the watertight integrity of the tool.

3.12 Finish. All finishes shall conform to specifications shown in the drawings listed in 2.1.2 and shall be free from nicks, burrs, and surface defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The contractor is responsible for ensuring that components and materials used are manufactured, examined, and tested in accordance with the referenced sections of this purchase description. Each part, subassembly, and assembly shall be inspected according to the inspection requirements specified in Table I.

4.3 Inspection procedure.

4.3.1 Dimensional verification. All components shall be checked for conformance with the dimensions and tolerances specified in the drawings referenced in 2.1.2. Measurement shall be conducted using instruments capable of measurements of ± 0.001 inch.

Table I. Inspection and Test Requirements

Inspection	Number of Sample Units	Requirement Paragraph	Method Paragraph	Number of Failures Allowed
Dimensions not as specified	All units	3.2	4.3.1	None
Materials not as specified	All units	3.3	4.3.2	None
Workmanship not as specified	All units	3.4	4.3.2	None
Interchangeability	All units	3.5	4.3.1	None
Assembly	All units	3.6	4.3.3	None
Threaded connections and fasteners	All units	3.7	4.3.2	None
Welding	All units	3.8	4.3.2	None
Bolted connections	All units	3.9	4.3.2	None
Required component weights	All units	3.10	4.3.4	None
Seals	All units	3.11	4.3.2	None
Finish	All units	3.12	4.3.2	None

4.3.2 Visual inspection. Visual inspection shall be performed for compliance with material and workmanship requirements specified in the drawings referenced in 2.1.2.

4.3.3 Mechanical assembly. Component assembly shall be conducted to verify form, fit, and function of individual manufactured components.

4.3.4 Weighing. Components that have weights specified in the drawings referenced in 2.1.2 shall be checked using a standard certified scale capable of ± 0.1 percent accuracy.

4.4 Inspection failure. Failure of production geotechnical tools to meet any requirement specified herein during and as a result of the specified inspection shall be cause for rejection of the production tools and shall be cause for refusal by the Government to continue acceptance of production tools until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

5. PREPARATION FOR SHIPMENT

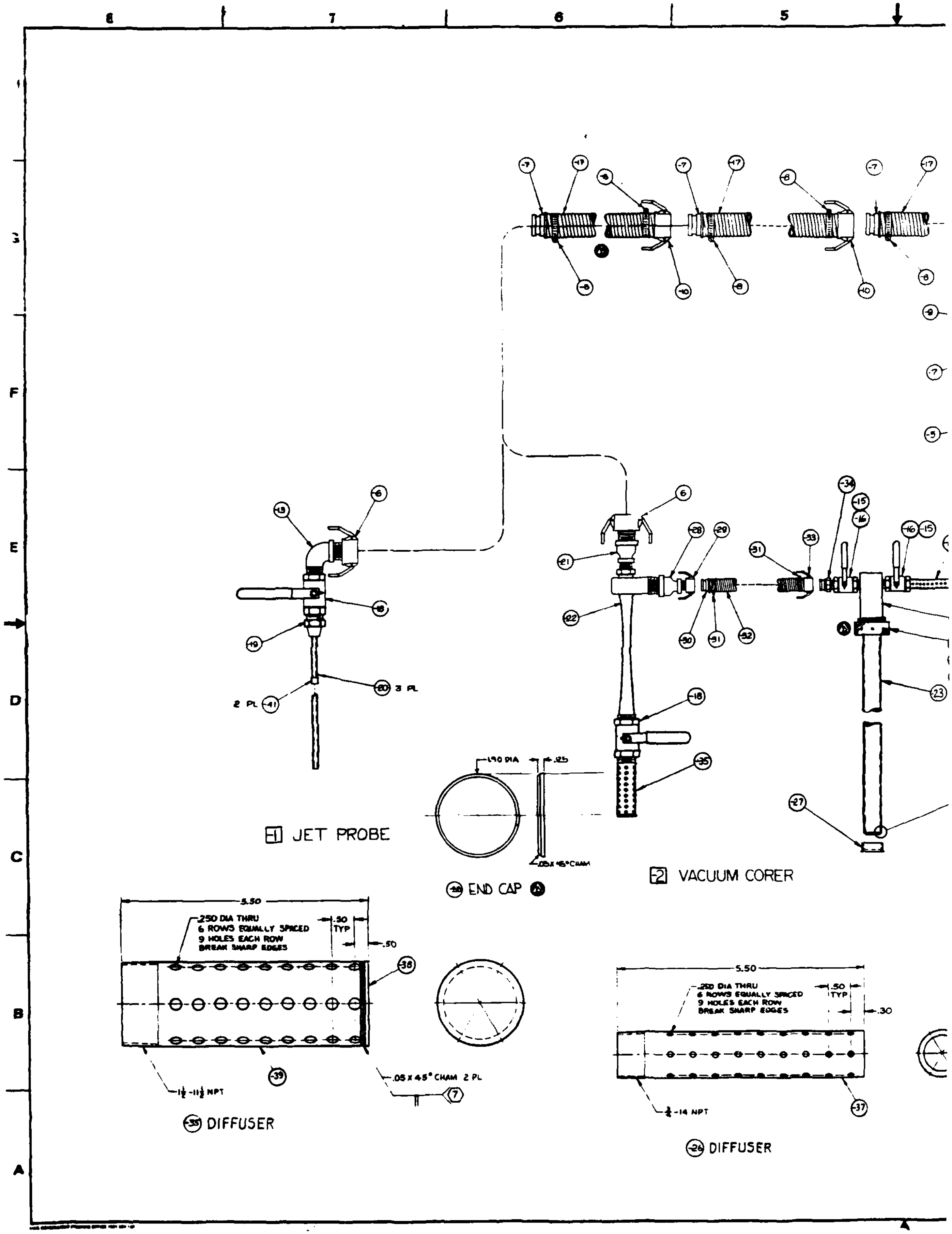
5.1 Preservation and packaging. All parts and subassemblies shall be preserved and packaged in accordance with MIL-STD-1188.

8.11.3 Manufacturers/Suppliers. Space is left to write in local suppliers.

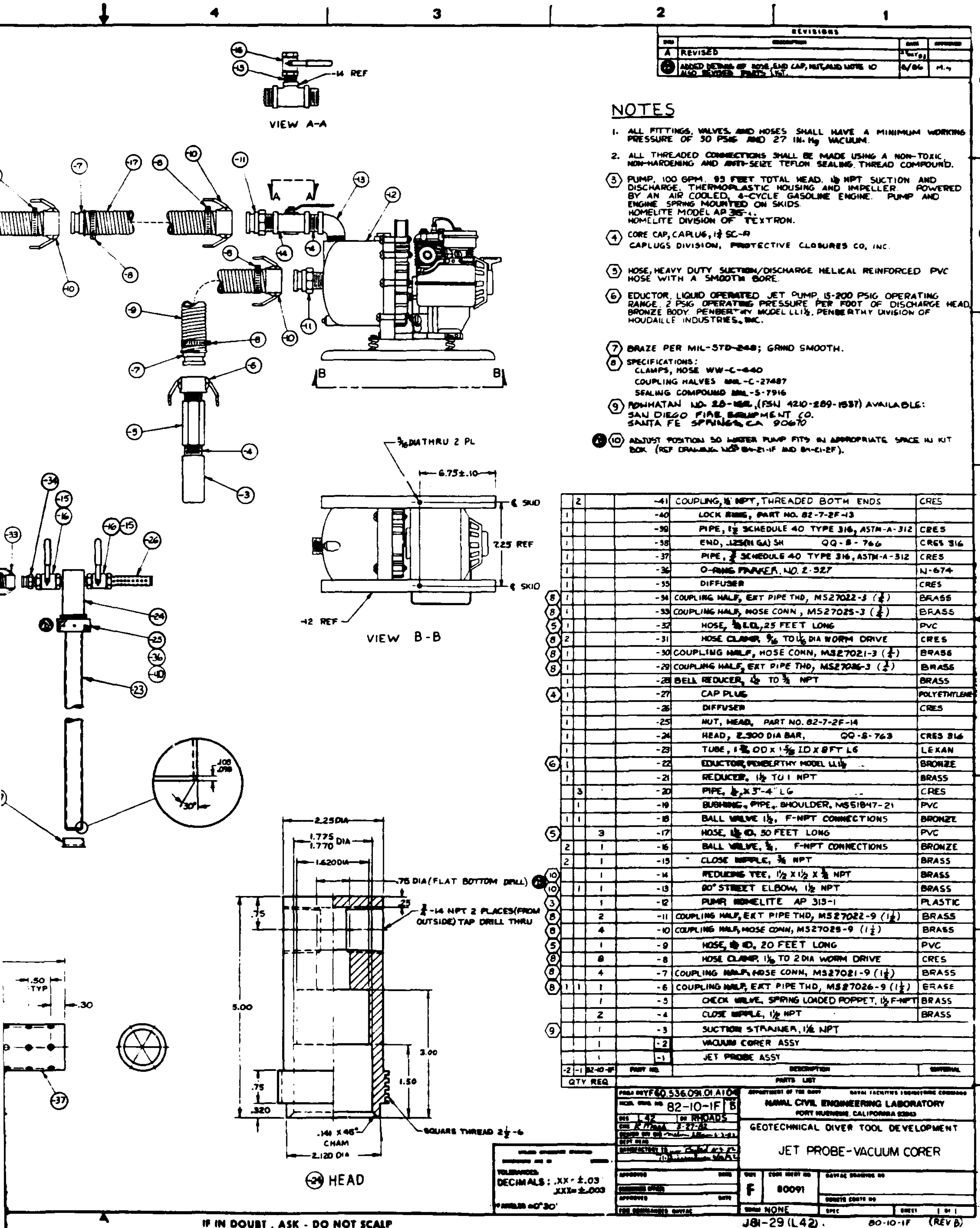
8.11.4 Drawings

The following drawings are included in this section:

Figure No.	NCEL Drawing No.	Title
8.20	82-10-1F	Jet Probe - Vacuum Corer
8.21	84-21-1F	Kit Box For Jet Probe - Vacuum Corer
8.22	84-21-2F	Kit Box For Jet Probe - Vacuum Corer
8.23	--	Diver's Slate - Jet Probe



E1 JET PROBE
E2 VACUUM CORER
END CAP
.190 DIA
.125
.05 X 45° CHAM
2 PL
3 PL
5.50
.250 DIA THRU
6 ROWS EQUALLY SPACED
9 HOLES EACH ROW
BREAK SHARP EDGES
.50
TYP
.50
.05 X 45° CHAM 2 PL
1½-11½ NPT
DIFFUSER
5.50
.250 DIA THRU
6 ROWS EQUALLY SPACED
9 HOLES EACH ROW
BREAK SHARP EDGES
.50
TYP
.30
¾-14 NPT
DIFFUSER



NOTES

1. ALL FITTINGS, VALVES AND HOSES SHALL HAVE A MINIMUM WORKING PRESSURE OF 30 PSIG AND 27 IN. Hg VACUUM.
2. ALL THREADED CONNECTIONS SHALL BE MADE USING A NON-TOXIC, NON-HARDENING AND ANTI-SEIZE TEFLON SEALING THREAD COMPOUND.
3. PUMP, 100 GPM, 95 FEET TOTAL HEAD, 1½ NPT SUCTION AND DISCHARGE, THERMOPLASTIC HOUSING AND IMPELLER. POWERED BY AN AIR COOLED, 4-CYCLE GASOLINE ENGINE. PUMP AND ENGINE SPRING MOUNTED ON SKIDS. HOMELITE MODEL AP 315-1, HOMELITE DIVISION OF TEXTRON.
4. CORE CAP, CAPLUG, 1½ SC-R CAPLUGS DIVISION, PROTECTIVE CLOSURES CO, INC.
5. HOSE, HEAVY DUTY SUCTION/DISCHARGE HELICAL REINFORCED PVC HOSE WITH A SMOOTH BORE.
6. EDUCTOR, LIQUID OPERATED JET PUMP, 15-200 PSIG OPERATING RANGE, 2 PSIG OPERATING PRESSURE PER FOOT OF DISCHARGE HEAD, BRONZE BODY. PENBERTHY MODEL LL1½, PENBERTHY DIVISION OF HOUDAILLE INDUSTRIES, INC.
7. BRAZE PER MIL-STD-248; GRIND SMOOTH.
8. SPECIFICATIONS:
   CLAMPS, HOSE WW-C-440
   COUPLING HALVES MIL-C-27487
   SEALING COMPOUND MIL-S-7916
9. POWHATAN NO. 28-MBL (FSN 4210-289-1537) AVAILABLE: SAN DIEGO FIRE EQUIPMENT CO. SANTA FE SPRINGS, CA 90670
10. ADJUST POSITION SO WATER PUMP FITS IN APPROPRIATE SPACE IN KIT BOX (REF DRAWING NOS 84-21-1F AND 84-21-2F).

Note	QTY REQ -2	QTY REQ -1	QTY REQ 82-10-1F	PART NO.	DESCRIPTION	MATERIAL
		2		-41	COUPLING, ½ NPT, THREADED BOTH ENDS	CRES
	1			-40	LOCK RING, PART NO. 82-7-2F-13	
	1			-39	PIPE, 1½ SCHEDULE 40 TYPE 316, ASTM-A-312	CRES
	1			-38	END, .125(11 GA) SH QQ-S-766	CRES 316
	1			-37	PIPE, ¾ SCHEDULE 40 TYPE 316, ASTM-A-312	CRES
	1			-36	O-RING PARKER, NO. 2-327	N-674
	1			-35	DIFFUSER	CRES
8	1			-34	COUPLING HALF, EXT PIPE THD, MS27022-3 (¾)	BRASS
8	1			-33	COUPLING HALF, HOSE CONN, MS27025-3 (¾)	BRASS
5	1			-32	HOSE, ¾ I.D., 25 FEET LONG	PVC
8	2			-31	HOSE CLAMP, 9/16 TO 1¼ DIA WORM DRIVE	CRES
8	1			-30	COUPLING HALF, HOSE CONN, MS27021-3 (¾)	BRASS
8	1			-29	COUPLING HALF, EXT PIPE THD, MS27026-3 (¾)	BRASS
	1			-28	BELL REDUCER, 1½ TO ¾ NPT	BRASS
4	1			-27	CAP PLUG	POLYETHYLENE
	1			-26	DIFFUSER	CRES
	1			-25	NUT, HEAD, PART NO. 82-7-2F-14	
	1			-24	HEAD, 2.500 DIA BAR, QQ-S-763	CRES 316
	1			-23	TUBE, 1⅞ OD x 1⅝ ID x 8FT LG	LEXAN
6	1			-22	EDUCTOR, PENBERTHY MODEL LL1½	BRONZE
	1			-21	REDUCER, 1½ TO 1 NPT	BRASS
		3		-20	PIPE, ½ x 3'-4" LG	CRES
		1		-19	BUSHING, PIPE, SHOULDER, MS51847-21	PVC
	1	1		-18	BALL VALVE 1½, F-NPT CONNECTIONS	BRONZE
5			3	-17	HOSE, 1½ ID, 50 FEET LONG	PVC
	2		1	-16	BALL VALVE, ¾, F-NPT CONNECTIONS	BRONZE
	2		1	-15	CLOSE NIPPLE, ¾ NPT	BRASS
10			1	-14	REDUCING TEE, 1½ x 1½ x ¾ NPT	BRASS
10		1	1	-13	90° STREET ELBOW, 1½ NPT	BRASS
3			1	-12	PUMP, HOMELITE AP 315-1	PLASTIC
8			2	-11	COUPLING HALF, EXT PIPE THD, MS27022-9 (1½)	BRASS
8			4	-10	COUPLING HALF, HOSE CONN, MS27025-9 (1½)	BRASS
5			1	-9	HOSE, 1½ ID, 20 FEET LONG	PVC
8			8	-8	HOSE CLAMP, 1⅛ TO 2 DIA WORM DRIVE	CRES
8			4	-7	COUPLING HALF, HOSE CONN, MS27021-9 (1½)	BRASS
8	1	1	1	-6	COUPLING HALF, EXT PIPE THD, MS27026-9 (1½)	BRASS
			1	-5	CHECK VALVE, SPRING LOADED POPPET, 1½ F-NPT	BRASS
			2	-4	CLOSE NIPPLE, 1½ NPT	BRASS
9			1	-3	SUCTION STRAINER, 1½ NPT	
			1	-2	VACUUM CORER ASSY	
			1	-1	JET PROBE ASSY	

PARTS LIST

PROJ NO YF60.536.091.01.A104 — DRAWING NO 82-10-1F — REV B

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

GEOTECHNICAL DIVER TOOL DEVELOPMENT

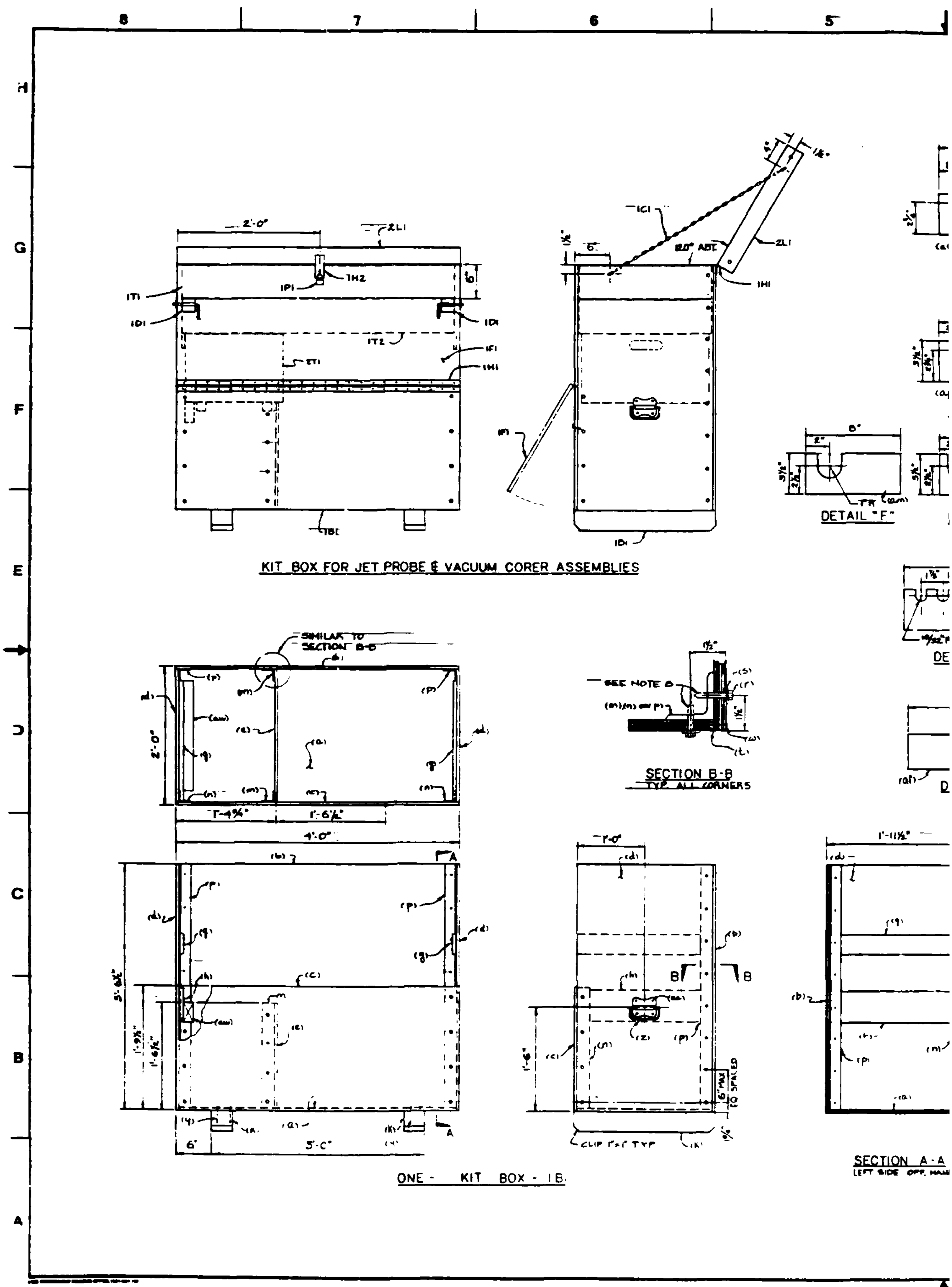
JET PROBE-VACUUM CORER

L42 — RHOADS — 5-27-82

SIZE F — CODE IDENT NO 80091 — SCALE NONE — SHEET 1 OF 1

J81-29 (L42) — 80-10-1F (REV B)

Figure 8.20. Jet probe-vaccum corer.


KIT BOX FOR JET PROBE & VACUUM CORER ASSEMBLIES
DETAIL "F"
SIMILAR TO SECTION B-B
SEE NOTE B
SECTION B-B
TYP ALL CORNERS
ONE - KIT BOX - 1B.
SECTION A-A
CLIP TYP TYP
6" MAX
EQ SPACED
2'-0"
4'-0"
1'-4¾"
1'-6¼"
1'-0"
1'-11½"
5'-0"
8"
2"

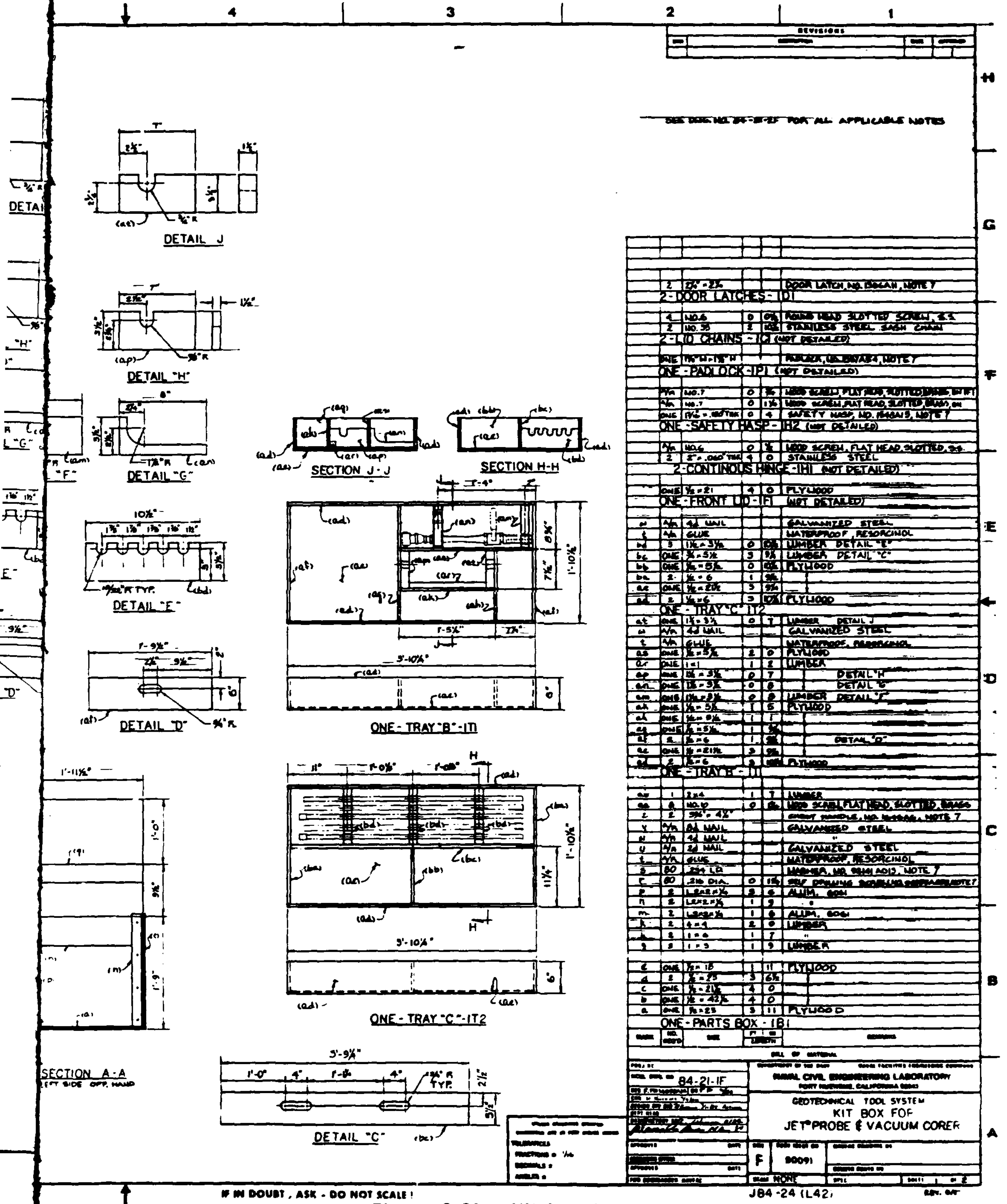
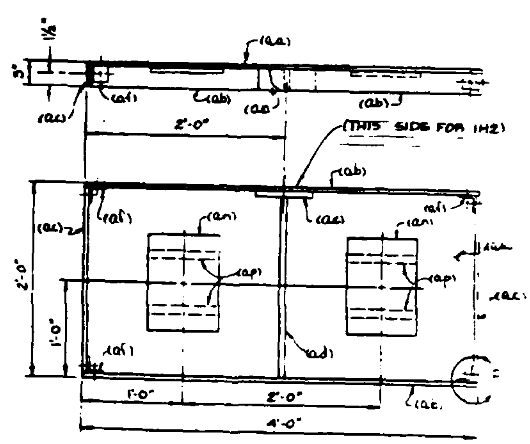
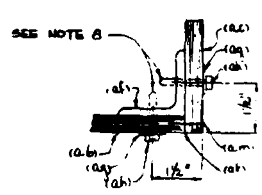


Figure 8.21. Kit box for jet probe and vacuum corer.



ONE - BOX LID - 2L



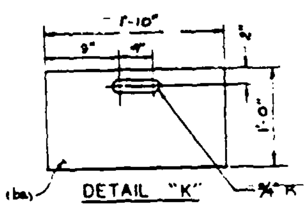
DETAIL "P"
TYP. 4 CORNERS

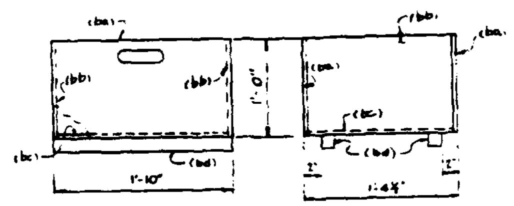
4 3 2 1

REVISIONS

NOTES:

1. ALL PLYWOOD SHALL BE STRUCTURAL I, C-C- EXTERIOR.
2. ALL LUMBER SHALL BE STANDARD DRESSED CONSTRUCTION GRADE DOUGLAS FIR, UNLESS OTHERWISE SHOWN.
3. ALL PORTRUDING SCREWS & NAILS, IF ANY, SHALL BE GROUND FLUSH.
4. ALL WOOD JOINTS SHALL BE GLUED AND NAILED 2" O.C. FOR 2d & 4d NAILS, 2½" FOR 8d.
5. APPLY PLASTIC COMPOUND TO ALL PLYWOOD EDGES, PRIM AND COAT SURFACES AND EDGES WITH EXTERIOR PAINT. FINISH COLOR TO BE GRAY.
6. ALL ROUGH EDGES & CORNERS ON WOOD AND ALUMINUM SHALL BE SANDED OR GROUND SMOOTH RESPECTIVELY.
7. AVAILABLE: McMASTER-CARR SUPPLY CO. LOS ANGELES, CA. 90054
8. ALL PORTRUDING SELF DRILLING SCREWS SHALL BE CUT AND GROUND FLUSH TO ALUMINUM ANGLES COUNTER PUNCH THREADS TO LOCK.





ONE - TRAY "A" - 2T

MARK	NO REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS
ak	N/R	GLUE			WATERPROOF RESORCINOL
am	N/R	4d NAILS			GALVANIZED STEEL
bd	2	2 x 2	1	10	LUMBER
bc	1	¼ x 15½	1	9	PLYWOOD
bb	2	¼ x 12	1	9½	"
ba	2	¼ x 12	1	10	PLYWOOD DETAIL "K"
	ONE - TRAY "A" - 2T				
ap	N/R	1" WIDE			VELCRO, HOOK & LOOP, ADHESIVE ATTACHMENT
an	2				CUPBOARD, NO. 1590T12, NOTE 7
am	N/R	4d NAILS			GALVANIZED STEEL
ak	N/R	GLUE			WATERPROOF RESORCINOL
ah	8	.216 DIA.	0	1¼	SELF DRILLING SCREW, NO. 90055A [illegible], NOTE 7
ag	8	.234 I.D.			WASHER, NO. 98141A013, NOTE 7
af	4	L2 x 2 x ⅛	0	2	ALUMINUM, 6061
ae	ONE	1 x 2½	0	7	LUMBER
ad	ONE	1 x 2½	1	10½	LUMBER
ac	2	½ x 2½	1	11	PLYWOOD
ab	2	½ x 2½	4	0	"
aa	ONE	½ x 24	4	0	PLYWOOD
	ONE - BOX LID - 2U				

BILL OF MATERIAL

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

NCEL DWG NO 84-21-2F

GEOTECHNICAL TOOL SYSTEM
KIT BOX FOR
JET PROBE & VACUUM CORER

TOLERANCES: FRACTIONS ± 1/16; DECIMALS ±; ANGLES ±

SIZE F | CODE IDENT NO 80091 | SCALE NONE | SHEET 2 OF 2

J84-24 (L 42) REV. E/A

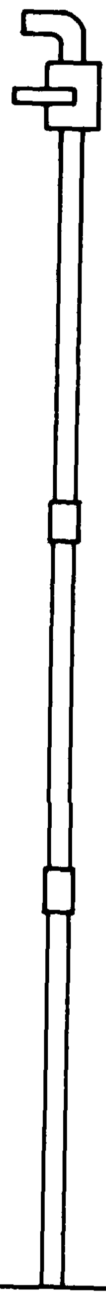
IF IN DOUBT, ASK - DO NOT SCALE

Figure 8.22. Kit box for jet probe and vacuum corer.

84-21-2F

USE SOFT LEAD PENCIL ONLY

JET PROBE



Site & Data ID	Depth (ft)	Bottom Description

NOTES:

Figure 8.23. Jet probe diver's slate. Engrave layout onto a 9x12x1/8-in. piece of white, high-impact styrene plastic, leaving a 1-in. border all around. Paint with black paint, wipe off while still wet, leaving black paint in grooves. Drill hole at top center of slate to attach line for pencil and for attaching slate to diver.

CHAPTER 9

VACUUM CORER

9.1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

9.1.1 General Information

The vacuum corer is a hand-operated diver tool that takes a soil sample 1.5 inches in diameter and up to 8 feet in length depending on the soil type. The vacuum corer runs off a water pump and an eductor that create the vacuum. A photograph of the vacuum corer is shown in Figure 9.1. The major parts of the tool are identified in the photograph. The vacuum corer is almost 9 feet long when assembled, and the vacuum corer plus eductor weighs 26 pounds in air and 18 pounds in seawater. It takes about 10 minutes to take a core with the vacuum corer.

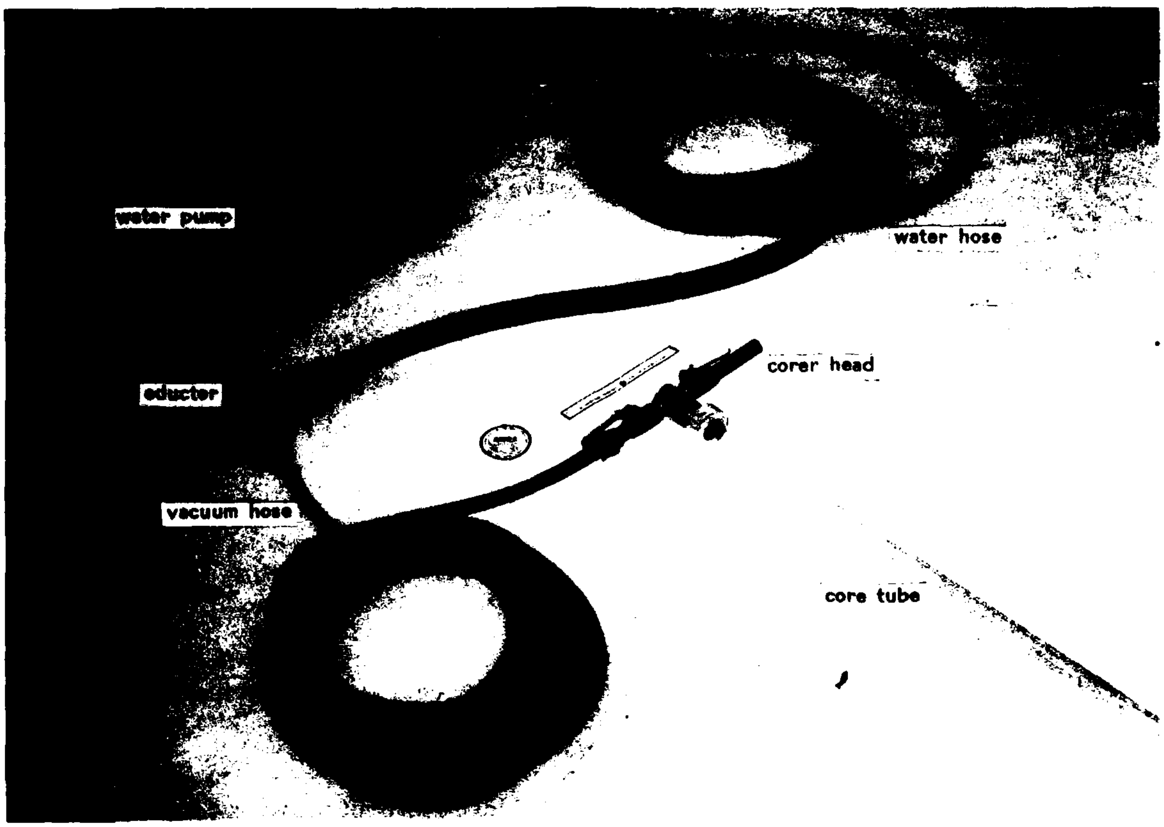


Figure 9.1. Vacuum corer.

The vacuum corer is packaged as a kit together with the jet probe kit in a box. This kit contains spare and repair parts for the vacuum corer. Support equipment and the water pump and hoses are shared between the two tools. The plywood box is 4 feet long by 2 feet wide by 4 feet tall. It weighs 450 pounds when fully equipped.

The geotechnical data obtained from the use of the vacuum corer are limited by the quality of the core. The core taken with the vacuum corer is a very disturbed core. It has limited use for testing in a geotechnical sense. The core is good for identifying the seafloor sediment to a depth greater than the impact corer can reach and it recovers a sample which the jet probe cannot do. The core can be used to obtain grain size, angularity, specific gravity, and other data, such as a range of friction angles in sands. (A specific friction angle cannot be obtained without knowing the in-situ density.) The core can be used to identify layers that may exist in the seafloor sediment. But since the vacuum corer does "vacuum," sediments may enter the oore tube in an uneven way. More of one type of soil will be sucked in than another and soil may be sucked in from the sides instead of from below the corer.

9.1.2 Safety Precautions

The vacuum corer presents several safety hazards; most of them are associated with the water pump, which is driven by a gasoline engine. See Chapter 7 for the safety precautions for the water pump. Safety precautions for the vacuum corer are listed below.

1. Aim eductor outflow away from work area.

2. Be careful with the 8-foot core tube when other divers are around. The clear core tube is nearly invisible underwater until there is some soil in it.

3. Use cleaning solvents and lubricants in a well-ventilated area only. Avoid prolonged breathing of the fumes or contact with the skin.

4. Store cores in a shaded area.

5. Store waterhoses with camlocks connected to prevent damage to connectors.

9.2 FUNCTIONAL DESCRIPTION

9.2.1 Introduction

This section provides a functional description of the vacuum corer and the theory of operation.

9.2.2 Tool Function

The vacuum corer's function is to take a soil sample 1.5 inches in diameter and up to 8 feet long in any type of seafloor soil that can be used to identify the soil type.

9.2.3 Functional Sequence

The vacuum corer and eductor are connected to the water pump. The vacuum corer and eductor are lowered into the water on a line. The water pump is started. The divers go to the seafloor with the tool and set up to take a core. When the divers are on the seafloor and at the correct spot, the eductor is placed away from the coring spot and the valve turned on. Diver #1 swims up with the corer head and holds the core tube vertical to the seafloor. Diver #2 guides the bottom of the core tube as it enters the soil. Diver #1 turns on the on-off valve and the vent valve and begins pushing the core tube into the seafloor. The divers must watch the core tube and try to control the rate at which soil is sucked up compared to the rate at which the core tube is pushed in. When the core tube is full, the vacuum is turned off and the core tube pulled out. Diver #2 at the bottom is ready to cap the bottom as soon as it comes out. The divers swim up with the corer and eductor. The core is brought to the surface and is capped and sealed.

9.2.4 Component Function and Theory of Operation

9.2.4.1 Water Pump. The water pump provides a source of pressurized water to flow through the eductor. This forced water flow through the eductor creates the vacuum that helps take a core.

9.2.4.2 Eductor. The eductor is connected to the water pump, and the water flowing through the eductor causes a suction or vacuum to be created in the vacuum hose attached to the eductor. Inside the eductor there is a venturi, or a section that narrows and then enlarges again. At this point, the water pumped through by the water pump speeds up to get through the narrower section. This causes a suction to form in the vacuum hose that is attached right at the narrowed section. This vacuum or suction is then used to help in getting a longer core out of the seafloor than is possible without it.

9.2.4.3 Vacuum Corer Head and Head Nut. The head on the vacuum corer holds the core tube and is connected to the vacuum hose. The head on the vacuum corer is very similar to the one on the impact corer. The difference is at the top where the vacuum corer has valves attached instead of handles. The parts are interchangeable. The head nuts are exactly the same. The O-ring in the head nut is specifically for the vacuum corer. The small gap in the lock ring is enough to lose some of the vacuum to the core tube. With O-ring in the head to seal the gap, the vacuum is more than strong enough to assist in taking a core.

9.2.4.4 Core Tube. The core tube is used to take the sample in and to store it in. The core tube material is the same as that used for the impact corer. The clear Lexan plastic allows the divers to see the core they are taking. This is important for the vacuum corer since it has a tendency to suck up too much soil. The core tube is 8 feet long and has an inside diameter of 1.5 inches. The top of the core tube is grooved so that the head nut and lock ring can grip it. The bottom of the core tube is bezeled to cut into the soil. The core tubing comes 8 feet long as a standard length. Three of the impact corer core tubes can be cut from one vacuum corer tube. The same core tube caps are used on both to seal the cores.

9.2.4.5 Vacuum Corer Control Valves. There are two valves for controlling the vacuum on the corer: an on-off valve and a vent. The on-off valve is used to either start or stop the vacuum flow to the core tube. The vent valve can be used to adjust the amount of vacuum that is applied to the core tube. The vacuum should be controlled so that the rate at which the core enters the core tube is the same as the rate at which the core tube is pushed into the soil. If this is the case, the level of the core in the tube would be even with the seafloor all the time. This is very difficult to do since the vacuum is hard to control and soils vary in the amount of vacuum needed to retrieve them. A soft soil or loose soil would not require as much vacuum as a very dense or stiff soil. If the soil is layered, then it will be very difficult to control the rate at which the core is retrieved. For this reason, the core taken with the vacuum corer is a very disturbed core. It has limited use for geotechnical testing, which tries to determine the properties of the soil in its natural condition.

9.3 ASSEMBLY, OPERATION, AND CORE HANDLING

9.3.1 Introduction

This section explains step-by-step the assembly, operation, and core handling for the vacuum corer. Before assembly and operation of the vacuum corer, Chapter 7 on the water pump and gasoline engine should be read and understood.

9.3.2 Assembly

The steps to assemble the vacuum corer are given below. Refer to the Illustrated Parts Breakdown to identify the parts.

ASSEMBLY STEPS

1. Prepare the water pump according to instructions in Chapter 7.

2. Attach the intake valve to the intake hose (Figure 9.2).

3. Attach the intake hose to the intake port on the water pump (Figure 9.2).

4. Attach the water hose to the discharge port on the water pump (Figure 9.2).

Figure 9.2. Water pump set up.

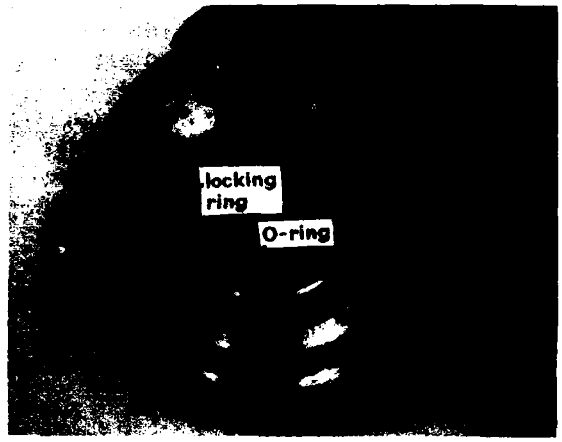


Figure 9.3. Vacuum corer head nut with lock ring and O-ring.

5. Place an O-ring in the head nut and a lock ring (Figure 9.3).

6. Put core tube into corer head and screw on head nut, using a lubricant such as Never-Seize on the threads. Turn both valves to off position.

7. Attach the vacuum hose to the corer head and to the eductor (Figure 9.4).

8. Attach the water hose to the eductor. Be sure that the eductor valve is turned off.

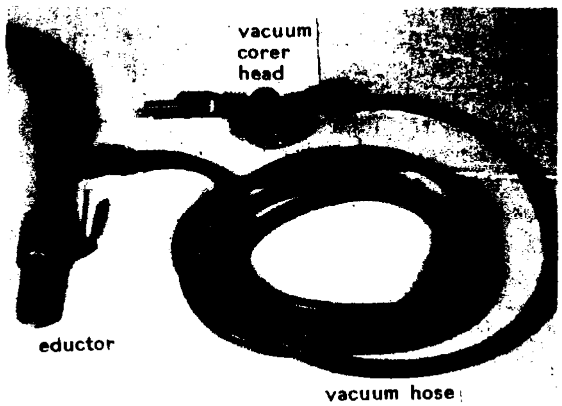


Figure 9.4. Eductor, vacuum hose, head.

9.3.3 Operation

The operation steps for the vacuum corer are listed below. Before operating the vacuum corer, Chapter 7 on the operation of the water pump should be read and understood.

OPERATION STEPS

1. Prime pump and start engine on water pump following manufacturer's instructions in Chapter 7.

2. Lower vacuum corer and eductor into water with a line.

3. Divers swim down to seafloor with corer and eductor.

4. Divers locate spot to take core.

5. Eductor is positioned away from coring location and turned on.

6. Diver #1 swims corer head up to a position so that the core tube is vertical to the seafloor (Figure 9.5).

Figure 9.5. Swimming with corer vertical.

7. Diver #2 is near the bottom of the core tube to help guide it into the seafloor vertically (Figure 9.6).

8. Diver #1 turns on the on-off valve and then opens and adjusts the vent to control the amount of vacuum (Figure 9.7).

9. Diver #1 pushes core tube into the soil, watching the coring progress and adjusting the vent valve to control the rate at which soil enters the core tube (Figure 9.8).

10. If soil is sucked into the vacuum line, the corer should be turned off. When the core tube is full, the valves on the corer head are shut off and the core tube is pulled out.

Figure 9.6. Positioning corer.

11. Diver #2, positioned near the bottom of the corer, should be ready with a cap to place on the bottom of the core tube as soon as it clears the seafloor.

12. Diver's swim up with core tube and corer.

13. Cap top of core tube and label with grease pencil until the core can be properly cared for and labeled.

9.3.4 Core Handling

The core taken with the vacuum corer is a disturbed core due to the nature of the coring method. This core should still be handled with care, though, to prevent further disturbance. The core handling steps listed below are similar to those for the impact cores, with some differences. See Chapter 3 for core handling information and photographs.

Figure 9.7. Turning on valves.

Figure 9.8. Embedded core tube.

CORE HANDLING STEPS:

1. Keep the core tube vertical until the core has been properly sealed.

2. The vacuum cores should be capped and taped on the bottom and then stood up in the shade. If there is no label on the core, label it at this time with a grease pencil. If there appears to be sediment at the top that is slurry-like, put a line at the top of the sediment with a grease pencil, and allow the core to stand until this appears to have settled. When the rate of settlement slows down to the point where there is no appreciable change in 15 minutes, measure the length of the core and record it. Also record the amount of settlement (inches) and the time it took to settle.

3. When the height of the core in the tube seems stable, use the hacksaw to cut the core tube off just above the soil. Do this carefully and try not to shake up the soil in the tube. There should be almost no air space at the top of the core between the sample and where the top of the cap will be.

4. Use a knife to smooth the rough edge of the sawn core tube.

5. Use a paper towel to clean and dry the top of the core tube and the cap that goes on the top.

6. Place the cap over the top end of the core tube. You may need to insert the tip of a knife under the edge of the cap to let trapped air escape. Push the cap down tight on the top of the core tube.

7. Use a grease pencil to write TOP on the top of the core tube cap.

8. Use black electrical tape to tape the cap onto the tube. Start the tape on the cap and stretch the tape as it is being wrapped around

the cap and tube. Cover the cap and about 1 inch of the core tube with about a dozen wraps of tape.

9. Now gently lay the core tube down horizontally; try not to let it roll around.

10. Carefully remove the bottom cap. If the soil is wet enough or loose enough to run out, tip the bottom of the core tube up.

11. Use a knife to scrape out any soil left in the bottom cap and place it back in the bottom of the care tube.

12. Wash out the cap and dry it with paper towels, getting all the soil grains out of the cap.

13. Clean off the outside of the bottom of the core tube with paper towels. It is very important to get all the soil off the core tube. If only one grain of soil is stuck between the cap and the core tube, it will provide a path for water no matter how tightly it is taped and sealed. Water will find that path and drain out of the sample. A drained sample has limited use for geotechnical testing.

14. Push the clean cap onto the clean core tube bottom. Again, use a knife tip to let trapped air escape and push the cap on tight.

15. Use black electrical tape to tape the bottom cap on as you did the top cap.

16. Write the core data ID on a 3x5 card, place the card in a plastic label bag, and tape it to the side of the core tube. Also, fill out a core data sheet (Figure 9.9).

17. Let the core tube stand vertically, top up, for a few hours to see if the bottom cap leaks. If water is found leaking from the core, redo steps 10 through 15.

18. When all the cores have been capped and taped and labeled, set up the paraffin warmer if it was brought out of the impact corer kit. This is not a necessary step if the cores are taped well, but it does help. Gasoline can be used as fuel. Set the pail of paraffin in the top and warm until the paraffin just melts. Do not let the paraffin get too hot; it will catch on fire. When it has just reached the melting point, dip the ends of the capped and taped core tubes in the paraffin. Let the sealed ends harden, vertically, out of direct sunlight, and as far away as possible from ship vibrations.

20. If these cores are to be shipped to a geotechnical lab, they will have to be packed according to their size.

21. When labeling the packed cores for shipping, identify the contents as ocean sediments rather than soils so they will not need to be inspected by the Department of Agriculture.

9.3.5Summary Instruction Sheet

The above instructions for assembly and operation of the vacuum corer have been condensed to one page with an illustrated parts breakdown on the back (Figure 9.10). A copy of this page can be laminated and kept in the kit box for quick field reference. These instruction are very brief, intended to function as a reminder, so the manual should be read first.

9.4 SCHEDULED MAINTENANCE

9.4.1 Introduction

Maintenance of the vacuum corer is performed periodically during storage and before and after use. Maintenance procedures for after use are presented here. Maintenance procedures for storage and before use are similar to those after use with a few exceptions, which will be noted. Refer to the illustrated parts breakdown in Section 9.7 to identify parts and tool breakdown.

9.4.2 After-Use Maintenance

The required maintenance steps for the vacuum core after use are listed below. Proper maintenance of the tool after use in saltwater will prolong its usefulness.

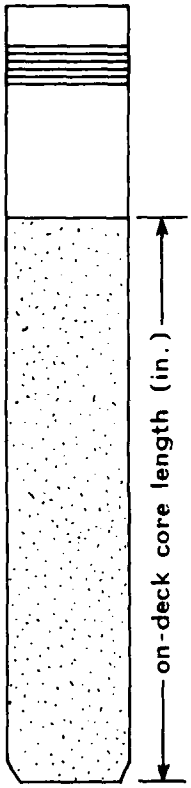
CORE DATA SHEET

Page

Project: ______________________________

Date: ______________ Time: ______________

Divers: ______________________________



Site + Core ID	On-Deck Core Length (in.)	Corer Penetration Depth Full | 3/4 | 1/2 | ?	Corer Penetration Easy/Hard

Observations: ______________________________

Problems: ______________________________

Figure 9.9. Core data sheet.

VACUUM CORER INSTRUCTION SHEET

(See Operation and Maintenance manual for complete instructions.)

. **SAFETY PRECAUTIONS:**

1. Be careful with core tube, it is nearly invisible underwater.
2. Aim eductor outflow away from work area.
3. See manual for proper operation and maintenance of water pump.

. **ITEMS DIVERS NEED:**

1. Vacuum corer with core tube in place
2. Core tube caps

. **TOOL ASSEMBLY:**

1. Attach intake valve to intake hose.
2. Attach intake hose to water pump (see manual for water pump operation).
3. Attach water hose (3 50-foot sections) to pump discharge.
4. Attach vacuum hose to eductor and corer head (valves closed).
5. Attach water hose to eductor (valves open).
6. Insert core tube (ribbed end) into corer head and tighten head nut.
7. Be sure there is an O-ring in head nut to get a good seal.

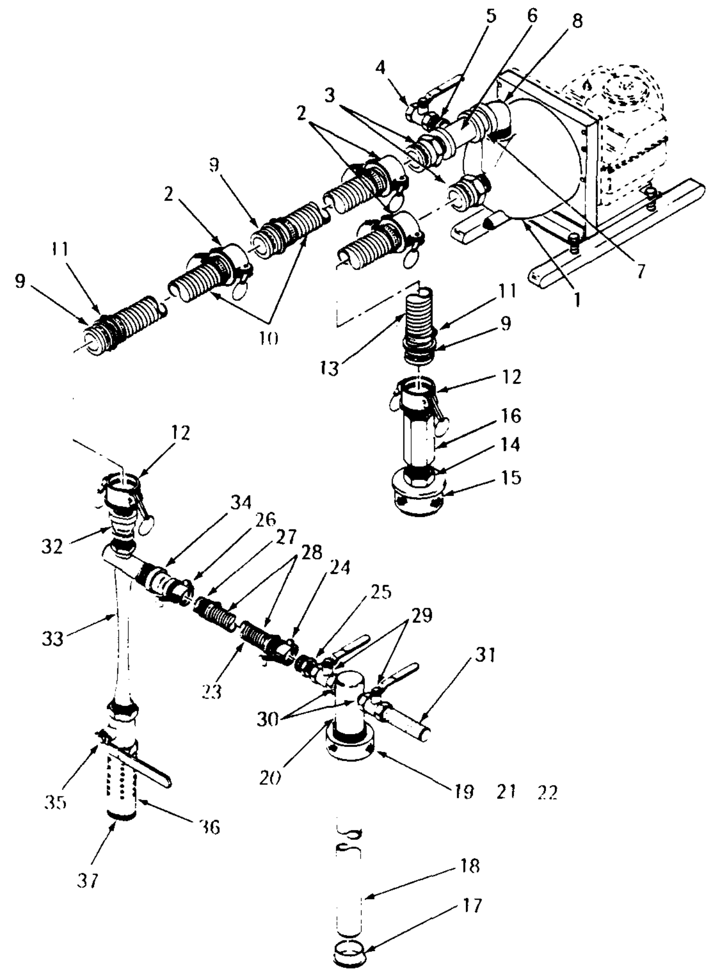
. **TOOL OPERATION:**

1. Turn on water pump.
2. Open valve on eductor (valves on corer head closed).
3. Raise corer until core tube is vertical.
4. Open one valve on corer head.
5. Start pushing core tube in and slowly open other valve.
6. Adjust suction while taking core to try to keep valve level of soil in core tube even with seafloor.
7. Turn off valve when core tube if full.
8. Take core to surface.
9. If vacuum hose fills with soil, or core needs to be dumped, close valve on eductor to backwash vacuum hose and core tube.
10. Follow instructions in manual for handling core.
11. Clean tool following manual instructions when finished.

DATA OBTAINED:

1. Core sample, properly capped and sealed for laboratory analysis.

Figure 9.10. Summary instruction sheet for vacuum corer.



1	Water pump	21	Lock ring
2	Camlock (female) brass	22	O-ring
3	Camlock (male) ext pipe thread, brass	23	Helical reinforced PVC hose (clear), 3/4 in. dia x 25 ft
4	Ball valve, 3/4-in.	24	Camlock, 3/4 in. (female)
5	Nipple, 3/4 NPT	25	Camlock, 3/4 in. (male) ext pipe thread
6	Reducing tee, 1-1/2 x 1-1/2 x 3/4 in. NPT	26	Camlock, 3/4 in. (female) ext pipe thread
7	Close nipple, 1-1/2-in. NPT	27	Camlock, 3/4 in. (male)
8	Elbow, 1/2-in. NPT x 42L	28	Hose clamp, 1/2 to 1-1/8 in. dia
9	Hose clamp, 1-1/2 in. dia	29	Ball valve, 3/4 in.
10	Helical reinforced PVC hose, 50 ft x 1-1/2 in. dia	30	Nipple, 3/4 in. NPT
11	Elbow, 90°, ST, 1-1/2 in. NPT	31	Pipe, 3/4 in. schedule 40, Type 316, ASTM-A-312 (Cres)
12	Camlock (female) ext pipe thread	32	Reduce, 1-1/2 to 1 in. NPT (brass)
13	Helical reinforced PVC hose, 1-1/2 in. dia x 20 ft	33	Eductor, Penberthy Model LL 1-1/2
14	Close nipple, 1-1/2 in. NPT	34	Bell reducer, 1-1/2 to 3/4 in. NPT
15	Suction screen, 1-1/2 in.	35	Ball valve, 1-1/ in.
16	Check valve (spring-loaded poppet)	36	Pipe, 1-1/2 schedule 40, Type 316, ASTM-A-312 (Cres)
17	Core tube cap	37	End
18	Core tube, 8 ft		
19	Head nut		
20	Corer head		

VACUUM CORER

AFTER-USE MAINTENANCE STEPS:

1. Remove core tube from tool, if it is still in. Unscrew all parts and break down tool.

2. Wash all parts with freshwater, use bucket and wire brush to clean threaded parts and to remove all soil from tool, and then dry tool (Figure 9.11).

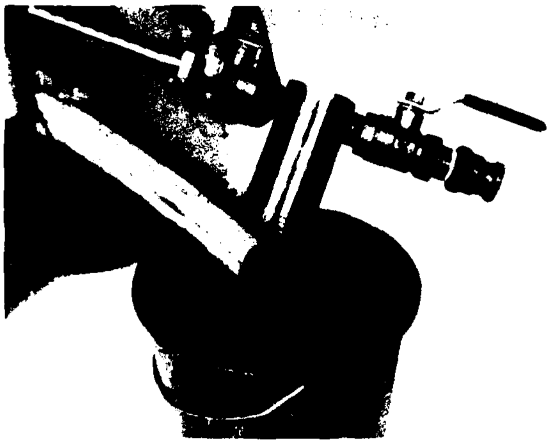


Figure 9.11. Cleaning threads.

3. Apply Never-Seize to all threads (Figure 9.12).

4. Apply silicone grease to O-rings and seals.

5. Apply a coat of a rust preventative, such as LPS-3, to all metal surfaces of the tool (Figure 9.13).

6. Store all parts separated; do not leave threaded parts screwed together to prevent galling.

7. Place tool parts back in kit box for storage.

8. Follow manufacturer's instructions in Chapter 7 for the water pump.

9. Clean and dry all items before placing in the kit box. Coat all metal parts with a rust preventor, such as LPS-3.

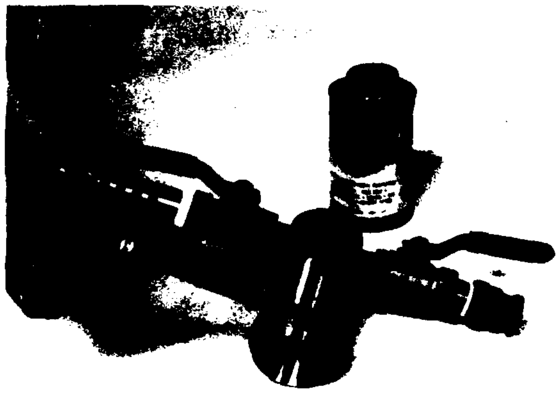


Figure 9.12. Lubricating threads.

Figure 9.13. Wiping down with rust preventative.

9.4.3 During-Storage Maintenance

The steps for during-storage maintenance are the same as steps 3 through 8 in after-use maintenance (if tool appears to be clean; otherwise also do steps 1 and 2) with the addition of the following step:

10. Check supplies in tool kit against list is Section 9.8 and restock as needed.

9.4.4 Before-Use Maintenance

The steps for before-use maintenance are the same as those for during-storage maintenance.

9.5 TROUBLESHOOTING

9.5.1 Introduction

This section presents some common problems that might occur in the operation of the vacuum corer. The troubleshooting procedures are listed in Table 9.1. See Section 9.6 for corrective maintenance procedures.

9.6 CORRECTIVE MAINTENANCE

Since the vacuum corer is a simple tool, all the necessary corrective maintenance procedures are listed in the Troubleshooting chart in Table 9.1. No specific maintenance procedures are listed here.

9.7 ILLUSTRATED PARTS BREAKDOWN

9.7.1 Introduction

This section contains the illustrated parts breakdown (IPB) for the vacuum corer. The IPB consists of a parts list (Table 9.2) and an illustration (Figure 9.14). The parts in the list are indexed to the illustration, and the indexing reflects the disassembly sequence.

9.7.2 Parts List

The parts list (Table 9.2) includes all major components, assemblies, and detail parts for the vacuum corer. The illustrations (Figure 9.14) in the parts list are indexed in sequence of disassembly. Each illustrated part shown disassembled is assigned an index number. Parts shown as assemblies are listed (whenever possible) with reference to the figure number that shows the part disassembled.

9.7.2.1 Figure and Index Number Column. The figure and index number column list is in numerical order. The figure and index number of each part is shown on the corresponding illustration.

9.7.2.2 Reference Designation Column. The reference designation column will remain blank because there are no designated electrical or electronic parts for the vacuum corer.

9.7.2.3 Part Number Column. The part number column lists the manufacturer or Government part number for all parts shown in the applicable drawings. An entry of COML designates that the part or material is generally available through a variety of commercial sources or vendors. This column may also contain a NO NUMBER entry, indicating that the part has no applicable part number but is identified for procurement by the data in the description column.

9.7.2.4 Indent Column. The numbers 1 through 3 in the indent column show the relationship of parts and subassemblies to assemblies and/or installations. For any given figure, a number 1 indent item is the top level of an assembly or installation, and a number 3 indent is the lowest level of disassembly.

9.7.2.5 Description Column. The description column contains descriptions of all parts listed in the applicable drawings. Modifiers are included to identify the characteristics of a particular item. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference. A cross-reference appears both in the listing where the assembly is first described and in the listing in which the assembly is broken down. In the latter, the abbreviation

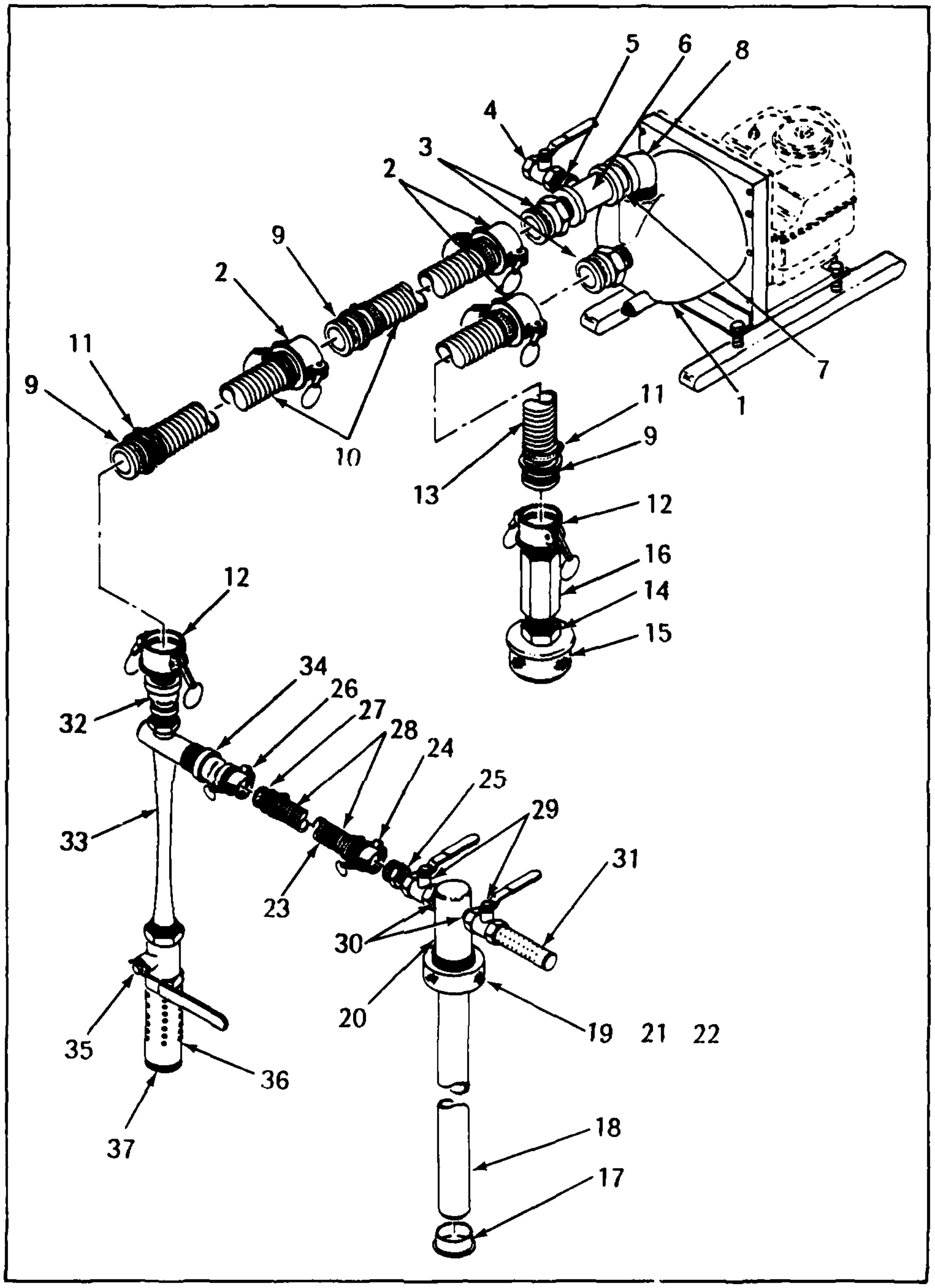


Figure 9.14. Vacuum corer.

REF appears in the quantity per assembly column. Abbreviations in the description column are generally in accordance with MIL-STD-12C and/or as noted in the list of abbreviations and acronyms.

9.7.2.6 Manufacturer's Code Column. The manufacturer's code column lists numbers identifying the suppliers of the parts. Table 9.3 lists both suppliers and codes, which are also available in the Federal Supply Code for Manufacturers, Cataloging Handbooks H4-1 and H4-2.

9.7.2.7 Quantity Per Assembly Column. The quantity per assembly column contains one of the following entries: a numeral indicating the quantity of the item used only at the indicated location or the abbreviation REF, indicating that the required quantity is listed on the figure referenced in the description column.

9.7.2.8 Used-On Code Column. This column will remain blank because there are no used-on codes applicable to this parts list.

9.7.3 Abbreviations and Acronyms

The abbreviations and acronyms listed in Table 9.4 appear in the parts list and in the text of this manual. Abbreviations used in the text may be in lower case letters, initial capitals with lower case letters, or all capitals. Abbreviations used in the parts list are in all capitals. The abbreviations and acronyms listed in Table 9.4 are in all capitals for consistency.

9.8 TOOL KIT

9.8.1 Introduction

This section explains the function of the tool kit and presents a list of the kit contents and the purpose of each item. Procurement information is given in Section 9.11. An Illustrated Parts Breakdown for the vacuum corer is given is Section 9.7.

9.8.2 Tool Kit Function

The vacuum corer tool kit is designed to be self-sufficient in the field with the exception of a source of freshwater, gasoline for the water pump engine, and the core tubes. The core tubes for the vacuum corer will have to be packaged separately, the size of the packaging depending on the number of tubes. Otherwise, the kit contains all the spare and repair parts and supplies to operate the vacuum corer in the field (Figure 9.15). The vacuum corer kit is packaged in the same box as the jet probe kit since the water pump and hoses and some of the support equipment is used by both tools. This box is of plywood construction, 4 feet long, 2 feet wide, and 4 feet tall. The complete box weighs 450 pounds when fully equipped. If only the vacuum corer is being used, the jet probe tray can be removed and left behind.

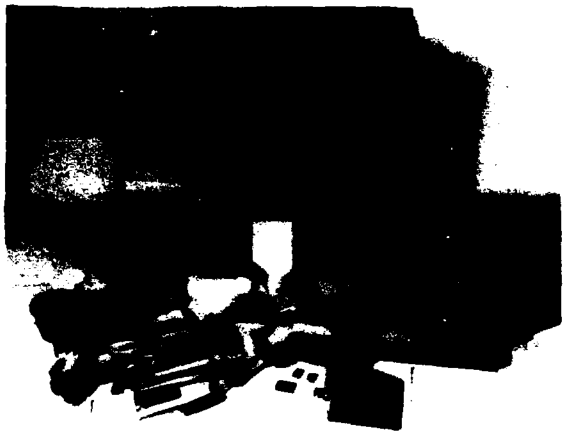


Figure 9.15. Jet probe/vaccum corer kit.

9.8.3 Tool Kit Contents

A list of the tool kit contents is shown in Table 9.5. The kit contents are listed as they are place in the kit box, from bottom (Figures 9.16, 9.17, and 9.18) to top (Figure 9.19) and from back to front. A brief explanation of the function of each item is given in Table 9.6.

Table 9.1. Troubleshooting - Vacuum Corer

Problem	Probable Cause	Corrective Action
Corer not taking up soil	1. Loss of suction	1. Check for O-ring in corer head.
		2. Check to see if there is suction by placing hand over bottom of core tube; if no suction, check condition of eductor and hoses, then water pump.
	2. Water pump not working	1. See Chapter 7.
Corer taking core too fast	1. Suction too strong	1. Close down valves on corer head to slow down coring rate.
Soil in vacuum hose	1. Coring not stopped soon enough	1. Backwash vacuum hose and core tube by closing valve on eductor and thereby forcing pump water through vacuum hose and core tube.

Table 9.2. Parts List - Vacuum Corer

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
9-14-0		82-10-1F	1	VACUUM CORER (FOR NHA SEE FIG ___)	80091	REF	
9-14-1		AP 315-1	2	PUMP, HOMELITE, AP 315-1 (PLASTIC)	35708	1	
9-14-2		MS27025-9	2	COUPLING, HALF, HOSE CONN, MIL-C-27487 (BRASS)	80091	3	
9-14-3		MS27022-9	2	COUPLING, HALF, EXT PIPE, MIL-C-27487 (BRASS)	80091	2	
9-14-4		1350-3/4	2	VALVE, BALL, 3/4 IN.	31995	3	
9-14-5		82-10-1F-15	2	NIPPLE, 3/4 NPT	80091	2	
9-14-6		82-10-1F-14	2	TEE, REDUCING, 1-1/2 X 1-1/2 X 3/4 IN. NPT (BRASS)	80091	1	
9-14-7		82-10-1F-4	2	NIPPLE, CLOSE, 1-1/2 IN. NPT (BRASS)	80091	2	
9-14-8		82-10-1F-20	2	PIPE, 1/2 IN. NPT X 42 L	80091	5	
9-14-9		6824	2	CLAMP, HOSE, 1 TO 2 IN. DIA	81646	6	
9-14-10		82-10-1F-17	2	HOSE, HEAVY DUTY SUCTION/ DISCHARGE HELICAL REINFORCED PVC HOSE WITH A SMOOTH BORE	80091	1	

continued

Table 9.2. Continued

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
9-14-11		82-10-1F-13	2	ELBOW, 90 DEG, ST, 1-1/2 IN. NPT (BRASS)	80091	2	
9-14-12		MS27026-0	2	COUPLING, HALF, EXT PIPE THD, MIL-C-27487 (BRASS)	80091	3	
9-14-13		82-10-1F-3	2	HOSE, 1-1/2 IN. ID, 20 FT L (PVC)	80091	1	
9-14-14		82-10-1F-4	2	NIPPLE, CLOSE, 1-1/2 IN. NPT (BRASS)	80091	2	
9-14-15		82-10-1F-3	2	SCREEN, SUCTION, 1-1/2 IN. FEM NPT	80091	1	
9-14-16		205	2	VALVE, CHECK, SPRING LOADED POPPET, 1-1/2 IN. FEM NPT	75336	1	
9-14-17		1-3/4 SC-R	2	CAP, CORE TUBE (POLYETHYLENE)	95760	1	
9-14-18		82-10-1F-23	2	TUBE, 1-3/4 OD X 1-5/8 ID X 8 FT L (LEXAN)	80091	1	
9-14-19		82-7-2F-8	2	NUT, HEAD	80091	1	
9-14-20		82-10-1F-24	2	HEAD, 2-1/4 IN. DIA BAR, QQ-S-763 (CRES 316)	80091	1	

continued

Table 9.2. Continued

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
9-14-21		82-7-2F-13	2	RING, LOCK	80091	1	
9-14-22		2-327-N602-70	2	O-RING	02697	1	
9-14-23		82-10-1F-32	2	HOSE, 3/4 IN. ID, 25 FT L (PVC)	80091	1	
9-14-24		MS27021-9	2	COUPLING, HALF, HOSE CONN (BRASS)	80091	1	
9-14-25		MS27022-3	2	COUPLING, HALF, EXT PIPE THD (BRASS)	80091	1	
9-14-26		MS27026-3	2	COUPLING, HALF, EXT PIPE THD (BRASS)	80091	1	
9-14-27		MS27021-3	2	COUPLING, HALF, HOSE CONN (BRASS)	80091	1	
9-14-28		6810	2	CLAMP, HOSE, 1/2 TO 1-1/8 IN. DIA	81646	2	
9-14-29		1350-3/4	2	VALVE, BALL, 3/4 IN.	31995	3	
9-14-30		82-10-1F-15	2	NIPPLE, 3/4 IN. NPT	80091	2	
9-14-31		82-10-1F-37	2	PIPE, 3/4 SCHEDULE 40, TYPE 3/6, ASTM-A-312 (CRES)	80091	1	

continued

Table 9.2. Continued

Figure & Index No.	Reference Designation	Part Number	Indent	Description	Manufacturer's Code	Quantity Per Assembly	Used-On Code
9-14-32		82-10-1F-21	2	REDUCER, 1-1/2 TO 1 IN. NPT (BRASS)	80091	1	
9-14-33		82-10-1F-22	2	EDUCTOR, PENBERTHY MODEL LL1-1/2 (BRONZE)	80091	1	
9-14-34		82-10-1F-28	2	REDUCER, BELL, 1-1/2 TO 3/4 IN. NPT (BRASS)	80091	1	
9-14-35		1350-1-1/2	2	VALVE, BALL, 1-1/2 IN.	31995	2	
9-14-36		82-10-1F-39	2	PIPE, 1-1/2 SCHEDULE 40, TYPE 316, ASTM-A-312	80091	1	
9-14-37		82-10-1F-38	2	END, 0.125, SH, QQ-S-766 (11 GA) (CRES 316)	80091	1	

Table 9.3. List of Manufacturers' Codes, Names, and Addresses

Code	Name and Address
02697	Parker-Hannifin Corporation Seal Group, O-Ring Division 2360 Palumo Drive Lexington, KY 40509
30781	Parker-Hannifin Corporation Packing Division 2220 S. 3600 W. Salt Lake City, UT 84119
31995	Jenkins Bros. 101 Merritt 7 Norwalk, CT 06851
35708	Textron Canada LTD Homelite-Terry Division 180 Labrosse Avenue P.O. Box 1800 Pointe Claire, Que Can H9R 4R6
39428	McMaster-Carr Supply Company P.O. Box 4355 Chicago, IL 60680
75336	Kingston F.C. Company 1007 N. Main Street Los Angeles, CA 90012
80091	Naval Facilities Engineering Command Washington, DC 20370
80094	Smith Herman H., Inc. 1913 Atlantic Avenue Manasquan, NJ 08736
81646	Ideal Corporation Sub of Parker-Hannifin Corporation 1000 Pennsylvania Avenue Brooklyn, NY 11207
95760	Protective Closures Company, Inc. 2150 Elmwood Avenue Buffalo, NY 14207
98773	Soiltest, Inc. 2205 W. Lee Street Evanston, IL 60202

Table 9.4. List of Abbreviations and Acronyms

Abbreviation/Acronym	Definition
AP	Attaching Part
ASSY	Assembly
ASTM	American Society for Testing and Materials
COML	Commercial
CONN	Connector
CRES	Corrosion Resistant Steel
DEG	Degree
DIA	Diameter
EXT	Extension
FEM	Female
FIG	Figure
FT	Feet
GA	Gage
GAPL	Group Assembly Parts List
ID	Inside Diameter
IN.	Inch/Inches
INSTL	Installation
IPB	Illustrated Parts Breakdown
L	Long
MSPT	Miniature Standard Penetration Test
NHA	Next Higher Assembly
NPT	National Taper Pipe (Thread)
OD	Outside Diameter
PT	Point
PVC	Polyvinyl Chloride
REF	Referenced
SQ	Square
SS	Stainless Steel
ST	Street
STD	Standard
SUBASSY	Subassembly
THD	Thread

Table 9.5. List of Contents - Jet Probe/Vacuum Corer

Item	No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier	Manufacturer/Supplier Part Number
1	1	Kit box			84-21-1F			
2	1	Water pump	8.20	8.14-1,3-8	82-10-1F	4,11-16	Homelite Div, Textron	AP-315-1
3	3	Water hose (50 ft)	8.20	8.14-2,9,11	82-10-1F	7,8,10,17	Local supplier	
4	1	Intake hose (20 ft)	8.20	8.14-2,9,11,13	82-10-1F	7,8,9,10	Local supplier	
5	1	Intake valve	8.20	8.14-12,14-16	82-10-1F	3,4,5,6	Local supplier	
6	1	Plastic bucket (4 qt)						FSN 7240-00-061-1163
7	1	Funnel						FSN 7240-00-527-9858
8	1	Wire brush (stainless steel)						FSN 7920-00-269-1259
9	1	Sparkplug					Champion	J8
10	2	Sparkplug socket, 3/8" drive						FSN 5120-00-678-2431
11	1	Handle, rachet, 3/8" drive						FSN 5120-00-240-5364
12	1	Extension, 3/8" x 2"						FSN 5120-00-243-1689
13	1	Adjustable wrench, 8"						FSN 5120-00-240-5328
14	1	Pliers, slip joint						FSN 5120-00-059-6711
15	1	Pliers, needlenose						FSN 5120-00-247-5177
16	1	Screwdriver, flat tip						FSN 5120-00-010-7915
17	2	Pipe wrenches, 18"						FSN 5120-00-277-1479
18	5	Hose mender (1-1/2")					Dixion	TM-21 (1-1/2")
14	10	Hose clamps (1-1/2")	8.20	8.14-11	82-10-1F	31	Local supplier	
20	1	Pipe dope					Locktite Pipe Sealant	59214
21	1	Silicone grease						FSN 6850-00-880-7616
22	1	Never-Seize						FSN 8030-00-180-6187
23	1	LPS-3 (1 gal bulk)					Local supplier	
24	1	Spray bottle - LPS-3						FSN 8125-00-488-7952
25	1	Spray bottle - water						FSN 8125-00-488-7952
26	2	Terry towel (pkg)						FSN 7920-00-823-9772
27	5	Lock ring	3.48	3.42-6	82-7-2F	13	Local machinist	
28	5	O-ring	8.20,9.20	9.14-22	82-10-1F	36	Local supplier	
29	100	3x5 cards						FSN MD 7530-00-247-6318
30	50	Plastic label bags						FSN 8105-00-756-2710
31	5	Electrical tape (rolls)						FSN 5970-00-788-4901
32	12	Black china markers						FSN 7520-00-223-6672
33	2	Tape measures						FSN 5210-00-054-1011

continued

Table 9.5. Continued

Item	No.	Kit Contents Description	Manual Figure Number	IPB Part Number	NCEL Drawing Number	NCEL Drawing Part No.	Manufacturer/Supplier Part Number	Manufacturer/Supplier
34	10	Wire pieces, 6"					Local supplier	
35	12	Pencils						FSN 7510-00-286-5757
36	2	Erasers						FSN 7510-00-323-8788
37	2	Hacksaw						FSN 5110-00-289-9651
38	1	Hacksaw blade (pkg)						FSN 5110-00-277-4591
39	1	Spanner wrench	3.48	3.42-18	82-7-2F	18		
40	1	Vacuum corer head	8.20,9.20	9.14-20,25,29-30	82-10-1F	15,16,24,26,34	Local machinist	
41	2	Head nut	8.20,9.20	9.14-19,21,22	82-10-1F	25	Local machinist	
42	1	Eductor assembly	8.20,9.20	9.14-12,26,32-37	82-10-1F	6,18,21,22,28,29,35	Local machinist/supplier	
43	1	Vacuum hose (3/4")	8.20,9.20	9.14-23,24,27,28	82-10-1F	30,31,32,33	Local supplier	
44	5	Hose mender (3/4")					Dixion	TM-6 (3/4")
45	10	Hose clamps (3/4")	8.20,9.20	9.14-28	82-10-1F	31	Local supplier	
46	50	Core data sheets	B-5, 9.9					
47	5	Planning sheet	B-1					
48	5	Summary sheet	B-2					
49	5	Site data sheet	B-3					
50	5	Site sketch sheet	B-4					
51	5	Tool fail. & inadeq. report	B-10					
52	1	Summ. inst. sht-vacuum corer	9.10					
53	5	Jet probe pipes (3' 4")	8.20	8.14-19	82-10-1F	20	Local supplier	
54	1	Jet probe head	8.20	8.14-12,17,20,21	82-10-1F	6,13,18,19	Local supplier	
55	10	Pipe couplings	8.20	8.14-18	82-10-1F	41	Local supplier	
56	1	Jet probe slate	8.23				Local shop	
57	100	Jet probe data sheets	B-9 (8.7)					
58	5	Planning sheet	B-1					
59	5	Summary sheet	B-2					
60	5	Site data sheet	B-3					
62	5	Site sketch sheet	B-4					
62	5	Tool fail. & inadeq. report	B-10					
63	12	Pencils						FSN 7510-00-286-5757
64	2	Erasers						FSN 7510-00-323-8788
65	1	Summ. inst. sht-jet probe	8.10					
PACKAGED SEPARATELY								
66	20	Core tubes (8')	9.20	9.14-18	82-10-1F	23	Local supplier	

Table 9.6. Function of Kit Contents

Item	Description	Function in Kit
1	Kit box	Contain kit contents; shipping package
2	Water pump	Pump water to tools (see Sections 8.2.4.1 & 9.2.4.1)
3	Water hose	Water flow from water pump
4	Intake hose	Intake water flow to pump
5	Intake valve	Filters intake flow
6	Plastic bucket	Bulk soil samples; hold water to clean tools; prime water pump
7	Funnel	Prime water pump
8	Wire brush	Clean tools
9	Sparkplug	Spare for water pump
10	Sparkplug socket	Repair water pump and tools
11	Rachet handle	Repair water pump and tools
12	Extension	Repair water pump and tools
13	Adjustable wrench	Repair water pump and tools
14	Pliers, slip-joint	Repair water pump and tools
15	Pliers, needlenose	Repair water pump and tools
16	Screwdriver	Repair water pump and tools
17	Pipe wrenches	Repair water pump and tools
18	Hose mender	Repair water and intake hoses
19	Hose clamps	Repair water and intake hoses
20	Pipe dope	Repair water pump and tools
21	Silicone grease	Lubricate O-ring
22	Never-Seize	Lubricate threads
23	LPS-3 (bulk)	Lubricate/rust preventative for tools
24	Spray bottle - LPS-3	Apply bulk LPS-3
25	Spray bottle - water	Clean head nut when changing core tubes
26	Terry towel	Clean and dry tools; wipe tool with rust preventor
27	Lock ring	Grips core tube inside head nut
28	O-ring	Seals vacuum corer head, especially gap in lock ring
29	3x5 cards	Label cores
30	Plastic label bags	Protect core labels
31	Electrical tape	Tape caps and labels on core tubes
32	Black china markers	Write on cores; write core labels
33	Tape measure	Measure core length
34	Wire pieces, 6"	"Burp" caps when putting on core tubes
35	Pencils	Record data on data sheets
36	Erasers	Correct mistakes on data sheets
37	Hacksaw	Cut off core tubes
38	Hacksaw blades	Refills for hacksaw
39	Spanner wrench	Loosen and tighten corer head nut
40	Vacuum corer head	Hold core tube
41	Head nut	Tightens to hold core tube in place
42	Eductor assembly	Creates suction in vacuum hose
43	Vacuum hose	Transfers suction to core tube
44	Hose mender	Mend vacuum hose breaks
45	Hose clamp	Hold hose menders in place
46	Core data sheet	Record information on cores
47	Planning sheet	Plan geotechnical site survey
48	Summary sheet	Summarize results of site survey
49	Site data sheet	Record data location coordinates
50	Site sketch sheet	Sketch site and mark and label data locations
51	Tool fail. & inadeq. report	Report problems with tools and kits
52	Summary inst. sheet	Quick-reference field use for tools
53	Jet probe pipes	Penetrate soil
54	Jet probe head	Control flow of jet probe
55	Pipe couplings	Connect jet probe pipes (spares)
56	Jet probe slate	Record jet probe data underwater; use pencil only; erase to clean
57	Jet probe data sheets	Record jet probe data; transfer from diver's slate
58	Planning sheet	Plan geotechnical site survey
59	Summary sheet	Summarize site survey
60	Site data sheet	Record data location coordinates
61	Site sketch sheet	Sketch site and mark and label data locations
62	Tool fail. & inadeq. report	Report problems with tools or kit
63	Pencils	Use on diver's slate and data sheets
64	Erasers	Clean diver's slate
65	Summary inst. sheet	Quick-reference guide for field use
66	Core tubes	Take and store cores

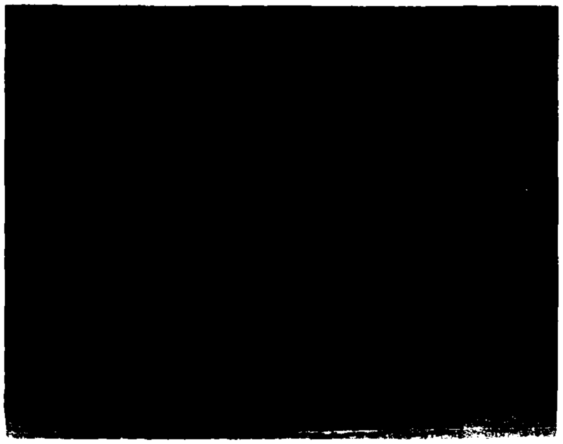


Figure 9.16. Bottom of jet probe/ vaccum corer kit box.

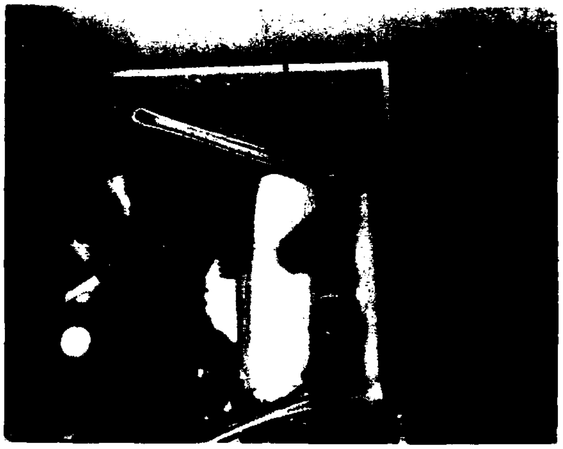


Figure 9.17. Tool box in jet probe/ vaccum corer kit box.

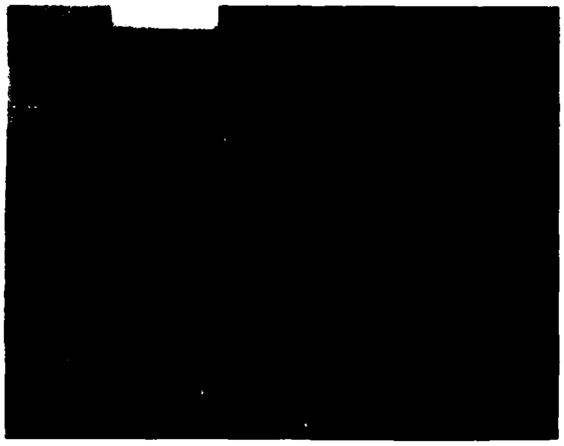


Figure 9.18. Vacuum corer tray in jet probe/vacuum corer kit box.

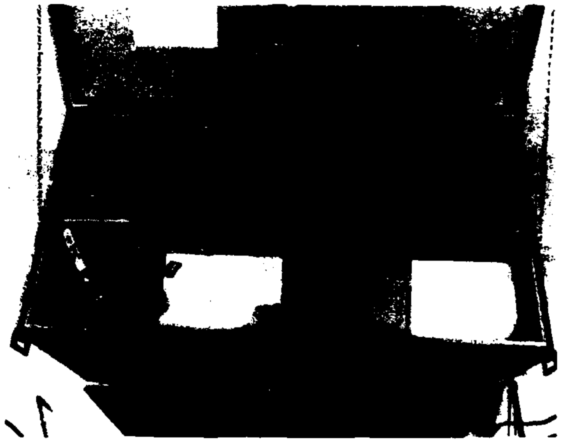


Figure 9.19. Jet probe tray in jet probe/vacuum corer kit box.

9.9 SHIPPING AND STORAGE

9.9.1 Introduction

The vacuum corer tool is designed to be stored in the kit box. The contents of the box were selected to allow it to be shipped by commercial or military truck, ship, or aircraft. Shipping regulations change with time, so check current regulations before shipping.

9.9.2 Storage

The contents of the vacuum corer kit shall be prepared for storage by ensuring that the proper maintenance has been done on the tools and that the other contents of the kit are also similarly prepared for storage (clean and prepared so as to prevent rusting). All parts of the tool kit can be stored in the kit box. During-storage maintenance should be performed at least once a year (see Section 9.4.3). For storage of the water pump, see the manufacturer's information in Chapter 7.

9.9.3 Shipping

Current shipping regulations should be checked before shipping the vacuum corer kit box. The items in the vacuum corer kit that require special handling for shipping are the gasoline engine on the water pump and the

rust preventative, LPS-3. For the LPS-3, special shipping can be avoided by using bulk LPS-3 rather than aerosol cans. The aerosol container is what requires special packaging. For the gasoline engine, the purging procedure to meet shipping regulations are presented in Chapter 7.

9.10 DATA ANALYSIS

9.10.1 Introduction

This section presents the type of testing possible on the cores recovered with the vacuum corer. Due to the disturbed nature of the core, the geotechnical testing possibilities are limited.

9.10.2 Geotechnical Data From Vacuum Cores

Due to the disturbed nature of the cores recovered with the vacuum corer, it is recommended that only the following tests be done.

1. ***Visual examination*** --A visual examination can be done on the vacuum core. Changes in soil type and color can sometimes be seen through the core tube.

2. ***Color*** --The wet and dry color of the soil can be determined using a Munsell color chart.

3. ***Grain size distribution*** --The grain size and percentage of each size can be determined by a mechanical sieve test and the smaller clay sizes by a hydrometer test.

4. ***Specific gravity*** --The specific gravity of the soil can be determined by laboratory tests since sample disturbance does not affect this quantity.

9.11 PROCUREMENT INFORMATION

9.11.1 Introduction

All the necessary information to procure the vacuum corer, the kit, and all its contents is contained within this manual. The information can be found in the following locations:

Table 9.5	List of Contents - Jet Probe/Vacuum Corer Kit
Section 9.7	Illustrated Parts Breakdown - Vacuum Corer
Section 9.11.2	Purchase Description
Section 9.11.3	Manufacturers/Suppliers
Section 9.11.4	Drawings
Appendix B	Data Sheets

Table 9.5 can be used as a master list to procure anything in the kit. Within the table is information such as drawings, manual figure numbers, part numbers, and manufacturers.

9.11.2 Purchase Description

1. SCOPE. This purchase description establishes the requirements for the manufacture and acceptance of the geotechnical diver tools. The geotechnical tools consist of a miniature standard penetration test (MSPT) device, vane shear, impact corer, vacuum corer, jet probe, and rock classifier.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DODISS) specified in the solicitation form a part of this purchase description to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-1188 - Commercial Packaging of Supplies and Equipment

(Copies of specifications and standards and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting

activity or as directed by the contracting officer.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this purchase description to the extent specified herein.

DRAWINGS

Figure No.	NCEL Drawing No.	Title
9.20	82-10-1F	Jet Probe-Vacuum Corer
9.21	84-21-1F	Kit Box for Jet Probe-Vacuum Corer
9.23	84-21-2F	Kit Box for Jet Probe-Vacuum Corer

(Copies of drawings required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this purchase description and the references cited herein, the text of this purchase description shall take precedence.

3. REQUIREMENTS

3.1 Drawings. The drawings referenced in 2.1.2 are level 2 end- product drawings. No deviation from the prescribed dimensions or tolerances is permissible without prior approval of the contracting officer. Where tolerances could cumulatively result in incorrect fits, the contractor shall provide tolerances within those prescribed on the drawings to ensure correct fit, assembly, and operation. Any data (such as shop drawings, layouts, flow sheets, and processing procedures) that are prepared by the contractor or obtained from a vendor to support fabrication and manufacture of the production item shall be made available, upon request, for inspection by the contracting officer or his designated representative.

3.2 Dimensions. All tool dimensions shall conform to the requirements specified in the end product drawings referenced in 2.1.2.

3.3 Materials. Materials shall be as specified herein and in other referenced documents. Materials not specified shall be selected by the contractor and shall be subject to all provisions of this purchase description. Materials shall be free from defects which adversely affect performance or serviceability of the finished product. Materials shall conform to the requirements specified in the end product drawings listed in 2.1.2.

3.4 Workmanship. All parts, components, and assemblies of the geotechnical tools, including machined surfaces, seals, and welded parts, shall be clean and free from any defects in workmanship. External surfaces shall be free from burrs, slag, sharp edges, and corners except where sharp edges or corners are required.

3.5 Interchangeability. All parts referenced in the drawings in 2.1.2 that are described by the same part number shall be physically and functionally interchangeable.

3.6 Assembly. The entire assembly shall be capable of multiple assembly and disassembly operations without degradation of components.

3.7 Threaded connections and fasteners. No threaded connections or fasteners shall show evidence of cross threading or mutilation.

3.8 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

3.9 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.10 Weights. Where indicated in drawings, weights of parts and subassemblies must be maintained within tolerances stated.

3.11 Seals. Where indicated in drawings, seals shall be installed with the necessary care required to maintain the watertight integrity of the tool.

3.12 Finish. All finishes shall conform to specifications shown in the drawings listed in 2.1.2 and shall be free from nicks, burrs, and surface defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspections specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection. The contractor is responsible for ensuring that components and materials used are manufactured, examined, and tested in accordance with the referenced sections of this purchase description. Each part, subassembly, and assembly shall be inspected according to the inspection requirements specified in Table I.

4.3 Inspection procedure.

4.3.1 Dimensional verification. All components shall be checked for conformance with the dimensions and tolerances specified in the drawings referenced in 2.1.2. Measurement shall be conducted using instruments capable of measurements of ± 0.001 inch.

4.3.2 Visual inspection. Visual inspection shall be performed for compliance with material and workmanship requirements specified in the drawings referenced in 2.1.2.

4.3.3 Mechanical assembly. Component assembly shall be conducted to verify form, fit, and function of individual manufactured components.

4.3.4 Weighing. Components that have weights specified in the drawings referenced in 2.1.2 shall be checked using a standard certified scale capable of ± 0.1 percent accuracy.

4.4 Inspection failure. Failure of production geotechnical tools to meet any requirement specified herein during and as a result of the specified inspection shall be cause for rejection of the production tools and shall be cause for refusal by the Government to continue acceptance of production tools until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiencies.

5. PREPARATION FOR SHIPMENT

5.1 Preservation and packaging. All parts and subassemblies shall be preserved and packaged in accordance with MIL-STD-1188.

9.11.3 Manufacturers/Suppliers. Space is left to write in local suppliers.

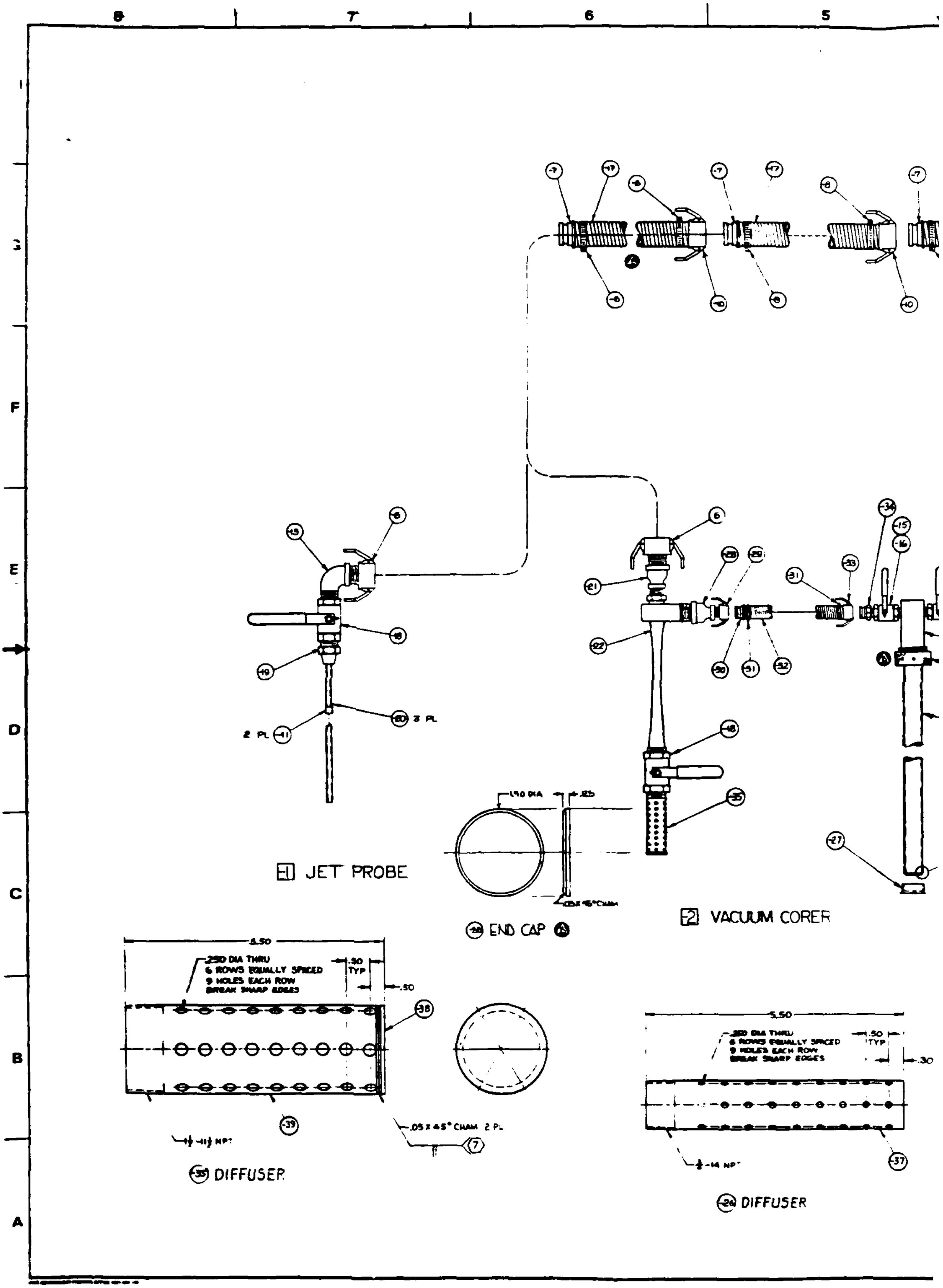
Table I. Inspection and Test Requirements

Inspection	Number of Sample Units	Requirement Paragraph	Method Paragraph	Number of Failures Allowed
Dimensions not as specified	All units	3.2	4.3.1	None
Materials not as specified	All units	3.3	4.3.2	None
Workmanship not as specified	All units	3.4	4.3.2	None
Interchangeability	All units	3.5	4.3.1	None
Assembly	All units	3.6	4.3.3	None
Threaded connections and fasteners	All units	3.7	4.3.2	None
Welding	All units	3.8	4.3.2	None
Bolted connections	All units	3.9	4.3.2	None
Required component weights	All units	3.10	4.3.4	None
Seals	All units	3.11	4.3.2	None
Finish	All units	3.12	4.3.2	None

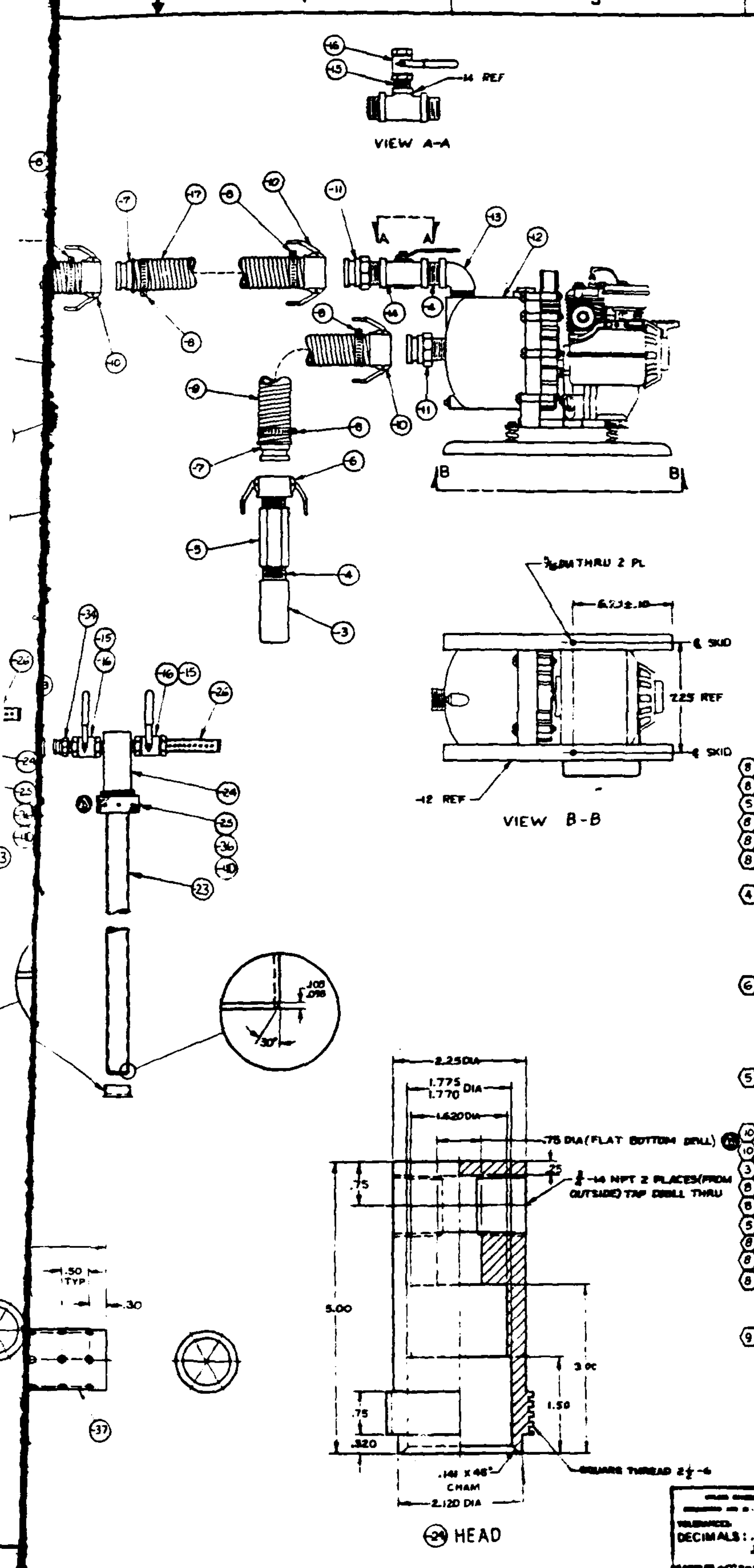
9.11.4 Drawings

The following drawings are included in this section:

Figure No.	NCEL Drawing No.	Title
9.20	82-10-1F	Jet Probe-Vacuum Corer
9.21	84-21-1F	Kit Box for Jet Probe-Vacuum Corer
9.23	84-21-2F	Kit Box for Jet Probe-Vacuum Corer
Appendix B	--	Data Sheets



8
7
6
5
G
F
E
D
C
B
A
E1 JET PROBE
E2 VACUUM CORER
END CAP
1.90 DIA
.125
5.50
.250 DIA THRU
6 ROWS EQUALLY SPACED
9 HOLES EACH ROW
BREAK SHARP EDGES
.30 TYP
.50
.05 X 45° CHAM 2 PL
DIFFUSER
.30
DIFFUSER
2 PL
3 PL



REV	DESCRIPTION	DATE	APPROVED
A	REVISED		
B	ADDED DETAIL OF TUBE, END CAP, NUT, AND NOTE 10 ALSO REVISED PARTS LIST.	6/84	

NOTES

1. ALL FITTINGS, VALVES, AND HOSES SHALL HAVE A MINIMUM WORKING PRESSURE OF 50 PSIG AND 27 IN. Hg VACUUM.
2. ALL THREADED CONNECTIONS SHALL BE MADE USING A NON-TOXIC, NON-HARDENING AND ANTI-SEIZE TEFLON, SEALING, THREAD COMPOUND.
3. PUMP, 100 GPM, 93 FEET TOTAL HEAD, 1 1/2 NPT SUCTION AND DISCHARGE, THERMOPLASTIC HOUSING AND IMPELLER. POWERED BY AN AIR COOLED, 4-CYCLE GASOLINE ENGINE. PUMP AND ENGINE SPRING MOUNTED ON SKIDS
   HOMELITE MODEL AP 315-1.
   HOMELITE DIVISION OF TEXTRON.
4. CORE CAP, CAPLUG, 1 1/2 SC-R
   CAPLUGS DIVISION, PROTECTIVE CLOSURES CO, INC.
5. HOSE, HEAVY DUTY SUCTION/DISCHARGE HELICAL REINFORCED PVC HOSE WITH A SMOOTH BORE.
6. EDUCTOR, LIQUID OPERATED JET PUMP, 15-200 PSIG OPERATING RANGE. 2 PSIG OPERATING PRESSURE PER FOOT OF DISCHARGE HEAD. BRONZE BODY. PENBERTHY MODEL LL1 1/2. PENBERTHY DIVISION OF HOUDAILLE INDUSTRIES, INC.
7. BRAZE PER MIL-STD-840; GRIND SMOOTH.
8. SPECIFICATIONS:
   CLAMPS, HOSE WW-C-440
   COUPLING HALVES MIL-C-27487
   SEALING COMPOUND MIL-S-7916
9. POWHATAN NO. 28-186 (FSN 4210-289-1837) AVAILABLE:
   SAN DIEGO FIRE EQUIPMENT CO.
   SANTA FE SPRINGS, CA 90670
10. ADJUST POSITION SO WATER PUMP FITS IN APPROPRIATE SPACE IN KIT BOX. (REF. DRAWING NO. 84-10-4F AND 84-10-2F).

NOTE	-2	-1	82-10-1F	PART NO.	DESCRIPTION	MATERIAL
		2		-41	COUPLING, 1/2" NPT, THREADED BOTH ENDS	CRES
	1			-40	LOCK RING, PART NO. 82-7-2F-13	
	1			-39	PIPE, 1 1/2 SCHEDULE 40 TYPE 316, ASTM-A-312	CRES
	1			-38	END, .125 (11 GA) SH QQ-S-766	CRES 316
	1			-37	PIPE, 1/2 SCHEDULE 40 TYPE 316, ASTM-A-312	CRES
	1			-36	O-RING PARKER, NO. 2-327	N-674
	1			-35	DIFFUSER	CRES
8	1			-34	COUPLING HALF, EXT PIPE THD, MS27022-3 (1/2)	BRASS
8	1			-33	COUPLING HALF, HOSE CONN, MS27025-3 (1/2)	BRASS
5	1			-32	HOSE, 1/2 I.D., 25 FEET LONG	PVC
8	2			-31	HOSE CLAMP, 5/16 TO 1 1/4 DIA WORM DRIVE	CRES
8	1			-30	COUPLING HALF, HOSE CONN, MS27021-3 (1/2)	BRASS
8	1			-29	COUPLING HALF, EXT PIPE THD, MS27026-3 (1/2)	BRASS
	1			-28	BELL REDUCER, 1/2 TO 3/8 NPT	BRASS
4	1			-27	CAP PLUG	POLYETHYLENE
	1			-26	DIFFUSER	CRES
	1			-25	NUT, HEAD, PART NO. 82-7-2F-14	
	1			-24	HEAD, 2.500 DIA BAR, QQ-S-763	CRES 316
	1			-23	TUBE, 1 7/8 OD X 1 5/8 ID X 8 FT LG	LEXAN
6	1			-22	EDUCTOR, PENBERTHY MODEL LL1 1/2	BRONZE
	1			-21	REDUCER, 1 1/2 TO 1 NPT	BRASS
		3		-20	PIPE, 1/2, X 3'-4" LG	CRES
		1		-19	BUSHING, PIPE, SHOULDER, MS51847-21	PVC
	1	1		-18	BALL VALVE 1 1/2, F-NPT CONNECTIONS	BRONZE
5			3	-17	HOSE, 1 1/2 ID, 50 FEET LONG	PVC
	2		1	-16	BALL VALVE, 1/2, F-NPT CONNECTIONS	BRONZE
	2		1	-15	CLOSE NIPPLE, 1/2 NPT	BRASS
10			1	-14	REDUCING TEE, 1 1/2 X 1 1/2 X 1/2 NPT	BRASS
10		1	1	-13	90° STREET ELBOW, 1 1/2 NPT	BRASS
3			1	-12	PUMP, HOMELITE AP 315-1	PLASTIC
8			2	-11	COUPLING HALF, EXT PIPE THD, MS27022-9 (1 1/2)	BRASS
8			4	-10	COUPLING HALF, HOSE CONN, MS27025-9 (1 1/2)	BRASS
5			1	-9	HOSE, 1 1/2 ID, 20 FEET LONG	PVC
8			8	-8	HOSE CLAMP, 1 5/16 TO 2 DIA WORM DRIVE	CRES
8			4	-7	COUPLING HALF, HOSE CONN, MS27021-9 (1 1/2)	BRASS
8	1	1	1	-6	COUPLING HALF, EXT PIPE THD, MS27026-9 (1 1/2)	BRASS
			1	-5	CHECK VALVE, SPRING LOADED POPPET, 1 1/2 F-NPT	BRASS
			2	-4	CLOSE NIPPLE, 1 1/2 NPT	BRASS
9			1	-3	SUCTION STRAINER, 1 1/2 NPT	
			1	-2	VACUUM CORER ASSY	
			1	-1	JET PROBE ASSY	

QTY REQ — PARTS LIST

TOLERANCES:
DECIMALS: .XX = ±.03
.XXX = ±.003
ANGLES ±0°30'

PROJ F60.536.091.01 A106
NCEL DWG NO 82-10-1F B
DES L42 DR RHOADS
CHK 8-27-82

NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA

GEOTECHNICAL DIVER TOOL DEVELOPMENT

JET PROBE-VACUUM CORER

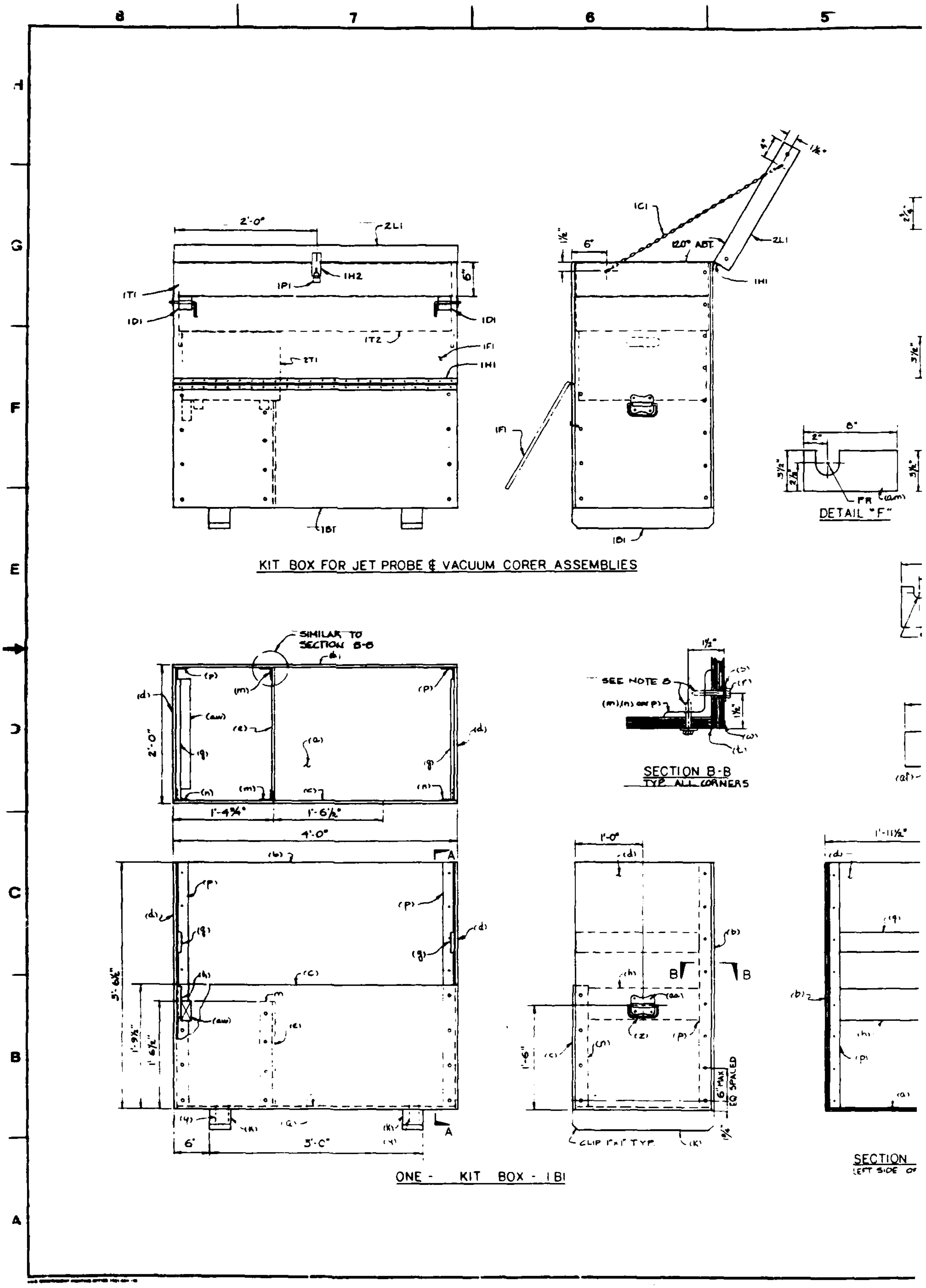
SIZE F CODE IDENT NO 80091
SCALE NONE SHEET 1 OF 1

J81-29 (L42) 80-10-1F (REV B)

82-10-1F

IF IN DOUBT, ASK - DO NOT SCALE!

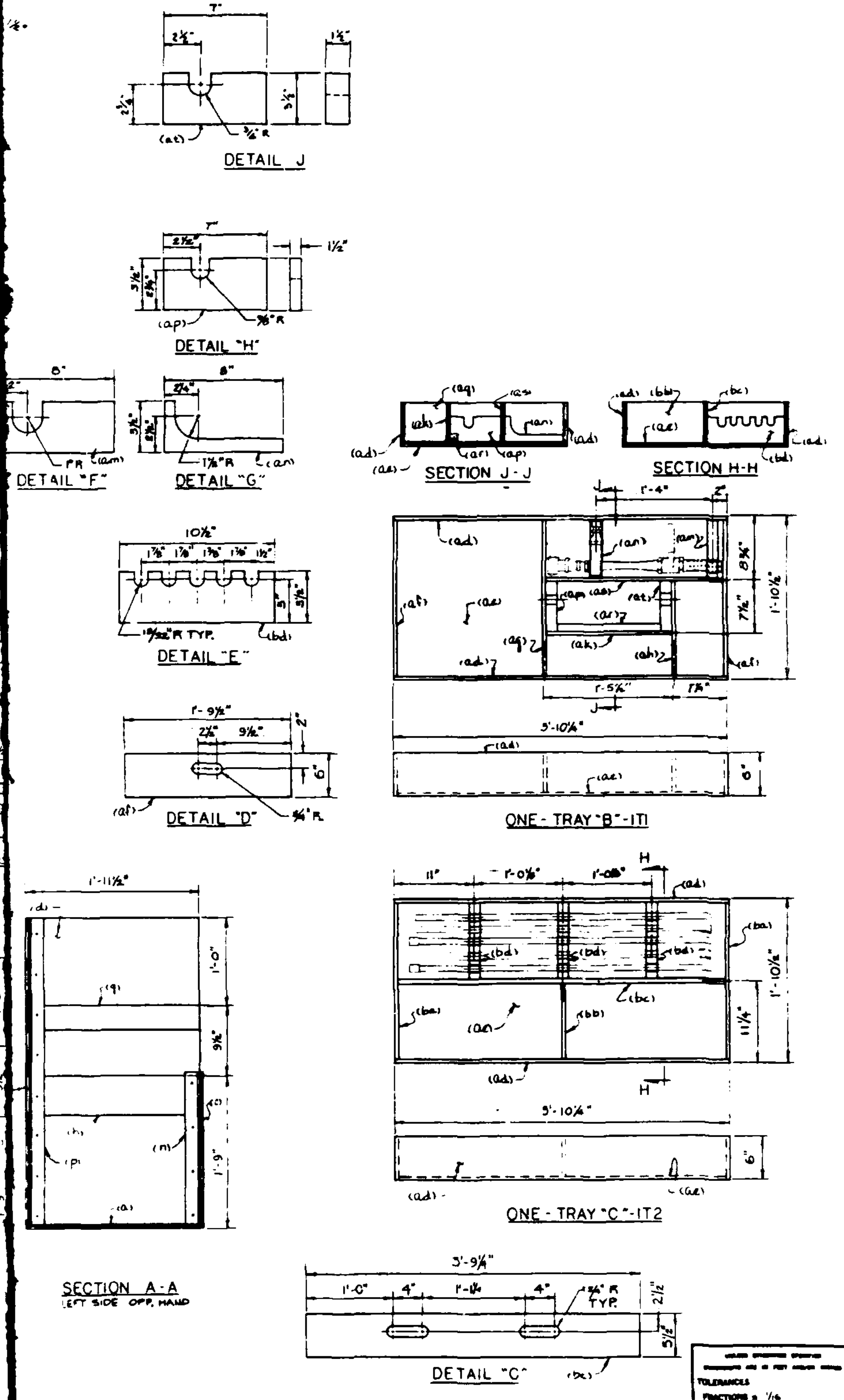
Figure 9.20. Jet probe-vacuum corer.



KIT BOX FOR JET PROBE ₵ VACUUM CORER ASSEMBLIES
SIMILAR TO SECTION B-B
SEE NOTE 8
SECTION B-B
TYP ALL CORNERS
DETAIL "F"
CLIP 1"x1" TYP.
6" MAX EQ SPACED
ONE - KIT BOX - 1B1
SECTION

SEE DWG. NO. 84-21-2F FOR ALL APPLICABLE NOTES

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVED



MARK	NO. REQ'D	SIZE	LENGTH FT	LENGTH IN	REMARKS
	2	2¼" × 2⅞	•		DOOR LATCH, NO. 1306A11, NOTE 7
	2 - DOOR LATCHES - 1D1				
	4	NO. 6	0	0⅜	ROUND HEAD SLOTTED SCREW, S.S.
	2	NO. 35	2	10½	STAINLESS STEEL SASH CHAIN
	2 - LID CHAINS - 1C1 (NOT DETAILED)				
	ONE	1⅝" W × 1⅜" H			PADLOCK, NO. 1551A54, NOTE 7
	ONE - PADLOCK - 1P1 (NOT DETAILED)				
	A/R	NO. 7	0	¾	WOOD SCREW, FLAT HEAD, SLOTTED, BRASS, ON 1F1
	A/R	NO. 7	0	1¼	WOOD SCREW, FLAT HEAD, SLOTTED, BRASS, ON
	ONE	1¾" × .150 THK	0	4	SAFETY HASP, NO. 1548A15, NOTE 7
	ONE - SAFETY HASP - 1H2 (NOT DETAILED)				
	A/R	NO. 6	0	½	WOOD SCREW, FLAT HEAD, SLOTTED, SS
	2	2" × .060" THK	4	0	STAINLESS STEEL
	2 - CONTINOUS HINGE - 1H1 (NOT DETAILED)				
	ONE	½ × 21	4	0	PLYWOOD
	ONE - FRONT LID - 1F1 (NOT DETAILED)				
w	A/R	4d NAIL			GALVANIZED STEEL
t	A/R	GLUE			WATERPROOF, RESORCINOL
bd	5	1½ × 3½	0	10½	LUMBER DETAIL "E"
bc	ONE	¾ × 5½	3	9¾	LUMBER DETAIL "C"
bb	ONE	½ × 5½	0	10½	PLYWOOD
ba	2	½ × 6	1	9¾	
ae	ONE	½ × 21½	3	9¾	
ad	2	½ × 6	3	10¾	PLYWOOD
	ONE - TRAY "C" 1T2				
at	ONE	1½ × 3½	0	7	LUMBER DETAIL J
w	A/R	4d NAIL			GALVANIZED STEEL
t	A/R	GLUE			WATERPROOF, RESORCINOL
as	ONE	½ × 5½	2	0	PLYWOOD
ar	ONE	1 × 1	1	2	LUMBER
ap	ONE	1½ × 3½	0	7	DETAIL "H"
an	ONE	1½ × 3½	0	8	DETAIL "G"
am	ONE	1½ × 3½	0	8	LUMBER DETAIL "F"
ak	ONE	½ × 5½	1	5	PLYWOOD
ah	ONE	½ × 9½	1	1	
ag	ONE	½ × 5½	1	9¾	
af	2	½ × 6	1	9¾	DETAIL "D"
ae	ONE	½ × 21½	3	9¾	
ad	2	½ × 6	3	10¾	PLYWOOD
	ONE - TRAY "B" - 1T1				
av	1	2 × 4	1	7	LUMBER
aa	8	NO. 10	0	1¼	WOOD SCREW, FLAT HEAD, SLOTTED, BRASS
z	2	3⅝" × 4¼"			CHEST HANDLE, NO. 1646A6, NOTE 7
y	A/R	8d NAIL			GALVANIZED STEEL
w	A/R	4d NAIL			"
u	A/R	2d NAIL			GALVANIZED STEEL
t	A/R	GLUE			WATERPROOF, RESORCINOL
s	80	.234 I.D.			WASHER, NO. 92141A013, NOTE 7
r	80	.216 DIA.	0	1¼	SELF DRILLING SCREW, NO. 94055A298, NOTE 7
p	2	L2 × 2 × ⅛	3	6	ALUM. 6061
n	2	L2 × 2 × ⅛	1	9	"
m	2	L2 × 2 × ⅛	1	6	ALUM. 6061
k	2	4 × 4	2	0	LUMBER
h	2	1 × 6	1	7	"
g	2	1 × 3	1	9	LUMBER
e	ONE	½ × 18	1	11	PLYWOOD
d	2	½ × 25	3	6½	
c	ONE	½ × 21½	4	0	
b	ONE	½ × 42½	4	0	
a	ONE	½ × 25	3	11	PLYWOOD
	ONE - PARTS BOX - 1B1				

BILL OF MATERIAL

TOLERANCES
FRACTIONS ± 1/16
DECIMALS ±
ANGLES ±

PROJ NO	DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NCEL DWG NO 84-21-1F	NAVAL CIVIL ENGINEERING LABORATORY, PORT HUENEME, CALIFORNIA 93043
	GEOTECHNICAL TOOL SYSTEM
	KIT BOX FOR JET PROBE & VACUUM CORER
APPROVED / DATE	SIZE F — CODE IDENT NO 80091
APPROVED / DATE	SCALE NONE — SHEET 1 OF 2

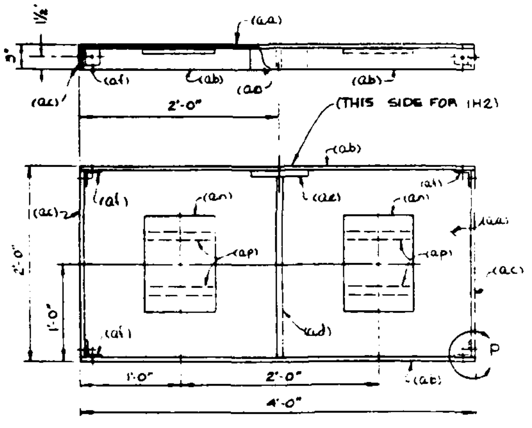
IF IN DOUBT, ASK - DO NOT SCALE!

J84-24 (L42)

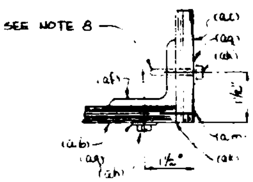
84-21-1F

Figure 9.21. Kit box for jet probe and vacuum corer.

8 7 6 5



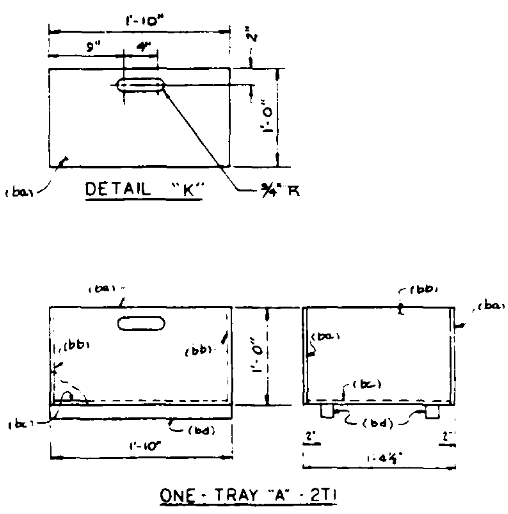
ONE - BOX LID - 2L1



DETAIL "P"
TYP. 4 CORNERS

NOTES:

1. ALL PLYWOOD SHALL BE STRUCTURAL I, C-C EXTERIOR.
2. ALL LUMBER SHALL BE STANDARD DRESSED CONSTRUCTION GRADE DOUGLAS FIR, UNLESS OTHERWISE SHOWN.
3. ALL PORTRUDING SCREWS & NAILS IF ANY, SHALL BE GROUND FLUSH.
4. ALL WOOD JOINTS SHALL BE GLUED AND NAILED 2" O.C. FOR 2d & 4d NAILS, 2½" FOR 8d.
5. APPLY PLASTIC COMPOUND TO ALL PLYWOOD EDGES, PRIM AND COAT SURFACES AND EDGES WITH EXTERIOR PAINT. FINISH COLOR TO BE GRAY.
6. ALL ROUGH EDGES & CORNERS ON WOOD AND ALUMINUM SHALL BE SANDED OR GROUND SMOOTH RESPECTIVELY.
7. AVAILABLE: McMASTER-CARR SUPPLY CO. LOS ANGELES, CA. 90054
8. ALL PORTRUDING SELF DRILLING SCREWS SHALL BE CUT AND GROUND FLUSH TO ALUMINUM ANGLES COUNTER PUNCH THREADS TO LOCK.



MARK	NO REQ'D	SIZE	FT	IN	REMARKS
ak	A/R	GLUE			WATERPROOF RESORCINOL
am	A/R	4d NAILS			GALVANIZED STEEL
bd	2	2×2	1	10	LUMBER
bc	1	½×15¼	1	9	PLYWOOD
bb	2	½×12	1	9½	"
ba	2	½×12	1	10	PLYWOOD DETAIL "K"
	ONE - TRAY "A" - 2T1				
ap	A/R	1" WIDE			VELCRO, HOOK & LOOP, ADHESIVE ATTACHMENT
an	2				CLIPBOARD, NO. 1598T12, NOTE 7
am	A/R	4d NAILS			GALVANIZED STEEL
ak	A/R	GLUE			WATERPROOF, RESORCINOL
ah	8	.216 DIA.	0	1¼	SELF DRILLING SCREW, NO. 94055A[illegible], NOTE 7
ag	8	.254 I.D			WASHER, NO. 92141A015, NOTE 7
af	4	L2×2×¼	0	2	ALUMINUM, 6061
ae	ONE	1×2½	0	7	LUMBER
ad	ONE	1×2½	1	10¾	LUMBER
ac	2	½×2½	1	11	PLYWOOD
ab	2	½×2½	4	0	"
aa	ONE	½×24	4	0	PLYWOOD
	ONE - BOX LID - 2L1				

BILL OF MATERIAL

NCEL DWG NO 84-21-2F

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CALIFORNIA 93043

GEOTECHNICAL TOOL SYSTEM
KIT BOX FOR
JET PROBE & VACUUM CORER

TOLERANCES:
FRACTIONS ± 1/16
DECIMALS ±
ANGLES ±

SIZE F | CODE IDENT NO 80091 | SCALE NONE | SHEET 2 OF 2

IF IN DOUBT, ASK - DO NOT SCALE!

J84-24 (L 42) REV 8/86

84-21-2F

Figure 9.22. Kit box for jet probe and vacuum corer.

APPENDIX A

GLOSSARY OF TERMS

Acoustic (seismic) profiling - A technique using reflected sound waves to develop a profile of the seafloor sediment.

Clay - A clay can be defined by three different methods:

(1) *Grain size* - All material with a grain size of less than 0.002 mm

(2) *Plasticity* - Determined by Atterberg limits testing in a geotechnical laboratory

(3) *Mineral content* - There are many different clay minerals; the most common are kaolinite, illite, and montmorillonite

Cohesionless (noncohesive) - A soil that does not exhibit cohesive properties. Its strength depends on the friction between the soil grains.

Cohesive soil - A soil in which the adsorbed water and particle attraction work together to produce the soil's strength. A cohesive soil will stick together when rolled around in your hand. It usually shrinks upon drying and expands when wetted. It loses strength when wet or when disturbed. It deforms plastically at varying water contents.

Disturbed soil sample - A soil sample that has been removed from its natural location and whose geotechnical properties have been greatly altered by its removal and subsequent handling. Sample disturbance can be caused by vibration, temperature changes, pressure changes, handling, and transporting methods.

Geology - An earth science that studies the materials comprising the earth, the form of the earth, fossils, the chronological sequence of rocks, minerals, composition of rocks, and the broad structure of the earth's rock.

Geotechnical engineering - A field of engineering that combines methods of scientific analyses of soil and rock, principles of soil mechanics, experience, and ingenuity to find economical and practical solutions to real-life problems of planning, design, construction, and operation of projects that interact with soil.

Gravel - Defined by grain size, generally 200 mm to 2 mm.

In situ - In the natural site.

Rock - Rock is defined by engineers as any indurated material that requires drilling and blasting or similar methods of brute force for excavation; minimum degree of induration about 200 psi compressive strength. This definition will vary among engineers, rock mechanicists, and geologists.

Sand - Defined by grain size, generally 2 mm to 0.075 or 0.05 mm; a cohesionless soil.

Silt - A silt is defined by grain size, between 0.075 and 0.002 mm, or around 0.05 to 0.002 mm. The grain size is determined by doing a sieve analysis in a laboratory. Silt is generally a cohesionless soil, although under the right circumstances it can behave cohesively.

Soil (and rock) mechanics - Describes the response of soil and rock masses to force systems. It is a branch of engineering science that deals with soil as a structural material.

Venturi - A tube with a center section that narrows and then widens, typically used as a meter to measure flow through the tube.

Symbols

kg = kilogram = 22 pounds

N = calibration number for rock classifier calibration anvil

R = rock classifier rebound number, read off scale on rock classifier

R_{cal} = average calibration rebound number for a particular rock classifier for a particular calibration test on the calibration anvil

R_f = final rebound number from averaged high five readings taken at one rock data location

R_{fc} = final, corrected rebound number for a rock data location, corrected for a R_{cal} that does not fall in range of $N \pm 2$

U/W = underwater

APPENDIX B

BLANK DATA SHEETS

GEOTECHNICAL SITE SURVEY PLANNING SHEET

I. GENERAL INFORMATION

1. Project: ______________________
2. Sponsor: ______________________
3. Point of Contact: ______________________
4. Telephone: ______________________
5. Purpose of Survey: ______________________
6. On-Site Dates: ______________________

II. SITE INFORMATION

7. Site of location: ______________________
8. Size of survey site: ______________________
9. How many data locations needed in site: ______________________
10. What is already known about site (soil type, water depth, slope, etc.): ______________________
11. Type of support facilities available: ______________________

III. SOIL DATA INFORMATION:

12. Type of data needed: ______________________
13. Laboratory soil analysis done by: ______________________
14. Geotechnical data analysis done by: ______________________

IV. GEOTECHNICAL TOOLS NEEDED — **NO. OF CORES/DATA NEEDED**

15. Impact corer ______________________
16. MSPT ______________________
17. Vane shear ______________________
18. Rock classifier ______________________
19. Jet probe ______________________
20. Vacuum corer ______________________

V. NOTES: ______________________

Figure B.1. A geotechnical site survey planning sheet.

Page

GEOTECHNICAL SITE SURVEY SUMMARY SHEET

GENERAL INFORMATION

Project: ______

Sponsor: ______

Point of Contact: ______

Phone: ______

Site Location: ______

On-Site Dates: ______

Divers: ______

Point of Contact: ______

Phone: ______

GEOTECHNICAL DIVER TOOLS

Tools Used	No. of Data Points	Tool Serial No.

SUMMARY SITE CHARACTERISTICS

SUMMARY OF PROBLEMS

Page

SURVEY SITE SKETCH SHEET

Project: ______________________ Date: __________

Site Location: ______________________ Scale: __________

LEGEND

⊗ Data location.

Page

SITE DATA SHEET

Site Location: ____________________

Benchmarks: ____________________

Navigation Method: ____________________

Data Location Identification	Coordinates		Water Depth (ft)	Visual Observation of Seafloor

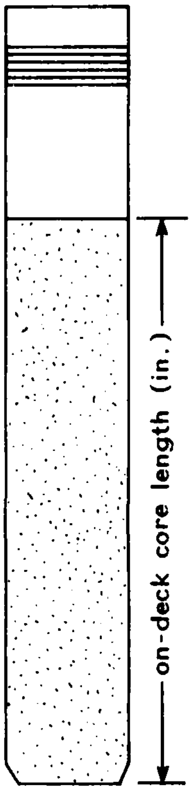
Page

CORE DATA SHEET

Project: ____________________

Date: ____________________ Time: ____________________

Divers: ____________________



Site + Core ID	On-Deck Core Length (in.)	Corer Penetration Depth Full|3/4|1/2|?	Corer Penetration Easy/Hard

Observations: ____________________

Problems: ____________________

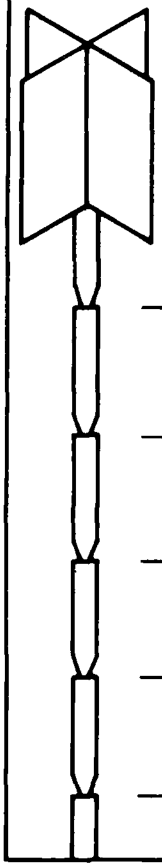
VANE SHEAR DATA SHEET

Project:

Date: Time:

Divers:

VANE SHEAR DATA FROM DIVER'S SLATE



Site + Data ID No.		
Vane Size		
Vane Serial No.		
Torque Wrench Serial No.		

DEPTH		TORQUE			
Mark	Inches	Original (in.-lb)	Remold (in.-lb)	Original (in.-lb)	Remold (in.-lb)
1	6				
2	12				
3	18				
4	24				
5	30				

Observations:

Problems:

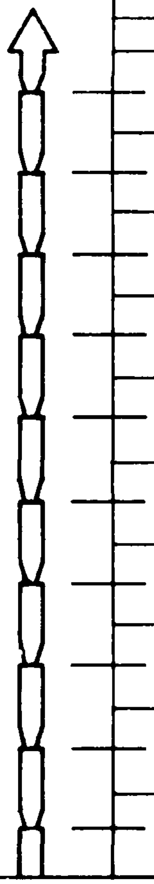
MSPT DATA SHEET

Project: ____________________

Date: ____________________ Time: ____________________

Divers: ____________________

MSPT DATA FROM DIVER'S SLATE



Site + Data ID No.					
Hammer Serial No.					
DEPTH		MSPT HAMMER BLOWS			
mark	inches				
1	3				
2	6				
3	9				
4	12				
5	15				
6	18				
7	21				
8	24				
9	27				
10	30				

Observations: ____________________

Problems: ____________________

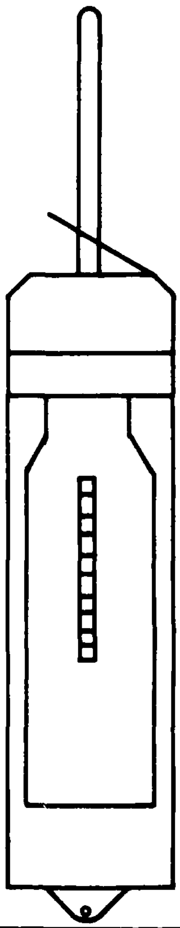
ROCK CLASSIFIER DATA SHEET

Project: ______________________________

Date: ________________ Time: ________________

Divers: ______________________________

ROCK CLASSIFIER DATA FROM DIVER'S SLATE				
Data Location ID				
Serial No.				
Readings	REBOUND NUMBER, R			
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				



Observations: ______________________________

Problems: ______________________________

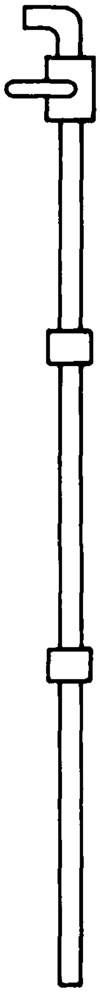
Rock Samples Collected:

JET PROBE DATA SHEET

Project: ______________________________

Date: ______________ Time: ______________

Divers: ______________________________



JET PROBE DATA FROM DIVER'S SLATE		
Site + Data ID	Depth (ft)	Bottom Description

Observations: ______________________________

Problems: ______________________________

GEOTECHNICAL TOOL FAILURE AND INADEQUACY REPORT

Geotechnical Diver Tool: ______________________________

Serial No.: ______________________________

Date Tool Failed: ______________________________

Site Location Where Tool Failed: ______________________________

CONDITIONS AT TIME OF FAILURE

Procedure or Test Being Performed: ______________________________

Seafloor Soil Conditions: ______________________________

Unusual Mechanical Conditions: ______________________________

Symptoms of Tool Failure or Inadequacy: ______________________________

CORRECTION OF FAILURE

Corrective Action Taken: ______________________________

Design Changes Recommended: No ☐ Yes ☐ — Explain ______________________________

Fold on line and staple.

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APPENDIX C

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